Figure 3-15. End-To-End Test Scenario–Phase 2

c) *ADS Configuration*. During Phase 2, connectivity with the GSMR, located at Fort Huachuca, AZ, will be provided by a DIS interface unit developed by the MISC. This will provide the second network connection for the Joint STARS Simulation and will provide interaction between the Joint STARS Simulation and the Synthetic Environment. In addition, the remaining nodes located at Fort Huachuca, the UAV and the ASAS, will be added to the DIS network using interface units also developed by the MISC. The node at Fort Sill, representing the Fire Direction Center (FDC) and the ATACMS, will be added at this time. This will complete the ETE DIS network. The architecture for Phase 2 is shown in Figure 3-16.

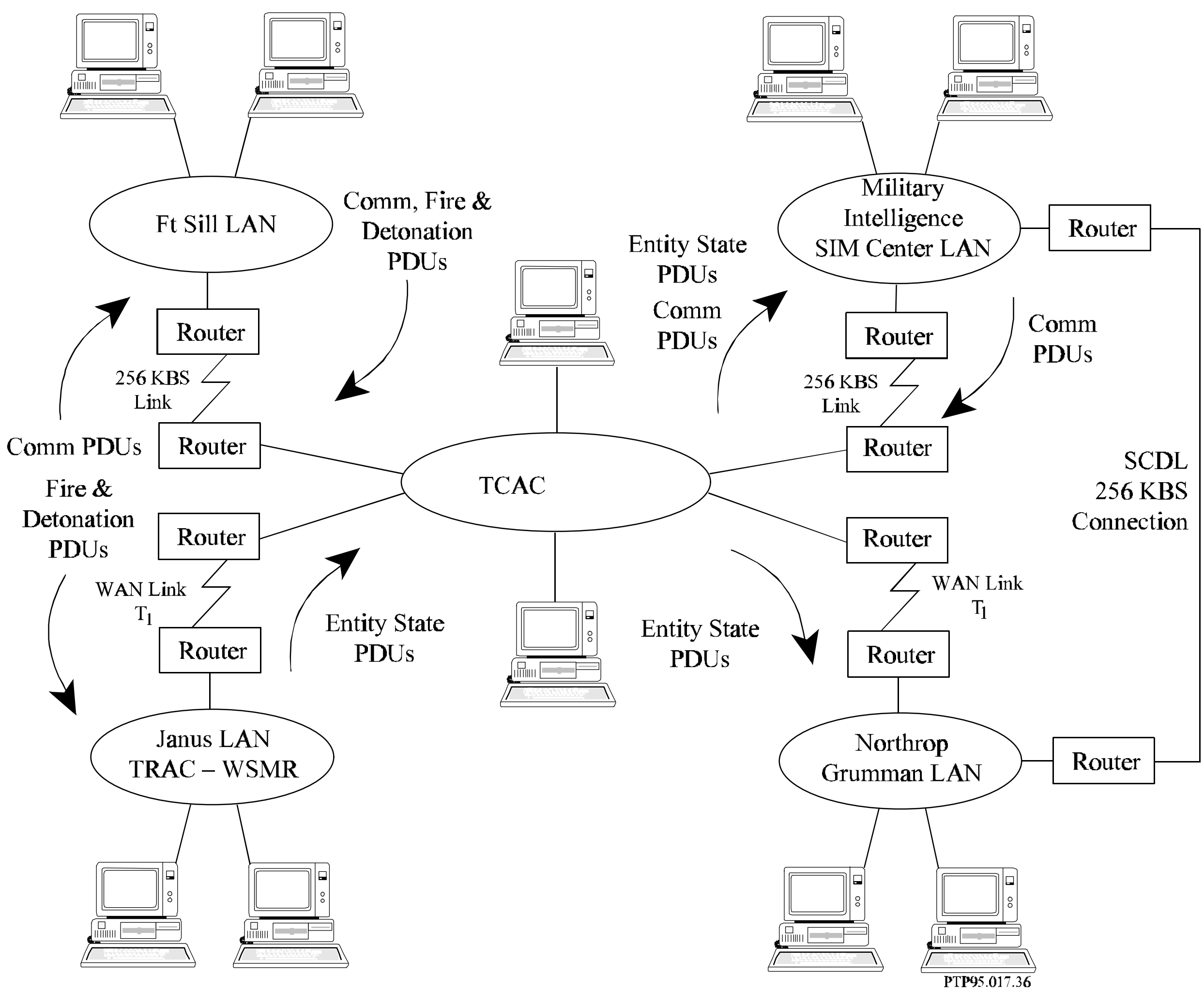

Figure 3-16. End-To-End Test ADS Architecture–Phase 2

d) *Test Participant Roles*. Phase 2 of the ETE will be accomplished in a joint effort by the JADS JTF, Northrop Grumman, TRAC-WSMR, The Depth and Simultaneous Attack Battle

Lab at Fort Sill, Oklahoma, hereafter referred to as the Fort Sill Battle Lab, and the MISC. The roles of each are as follows:

JADS JTF

- Overall responsibility for the planning, execution, analysis, and reporting of the test.
- Develops ADS measures and related events.
- Analyzes and evaluates ADS measures.
- Reports interim and final results to OSD.
- Develops the Phase 2 Test Plan.
- Develops V&V plan for ETE Phase 2.
- Establishes necessary communication links with test participants.
- Activates ETE DIS Network.
- Develops necessary scenarios for ETE Phase 2.

Northrop Grumman

- Supports activation of ETE DIS Network.
- Supports testing/benchmarking/modification of ETE DIS Network.
- Supports conduct of ETE Phase 2 Events.

TRAC-WSMR

- Supports activation of ETE DIS Network.
- Supports testing/benchmarking/modification of ETE DIS Network.
- Supports conduct of ETE Phase 2 Events.

Fort Sill Battle Lab

- Supports activation of ETE DIS Network.

- Supports testing/benchmarking/modification of ETE DIS Network.

- Supports conduct of ETE Phase 2 Events.

Military Intelligence Simulation Center

- Supports activation of ETE DIS Network.

- Supports testing/benchmarking/modification of ETE DIS Network.

- Supports conduct of ETE Phase 2 Events.

Joint STARS Joint Program Office

- Provide contract support for Northrop Grumman tasks.

- Supports conduct of ETE Phase 2 SUT Test Events.

- Authorize access to MOT&E data.

e) *Test Tasks.* The schedule of top level tasks and activities for Phase 2 is given in Figure 3-17.

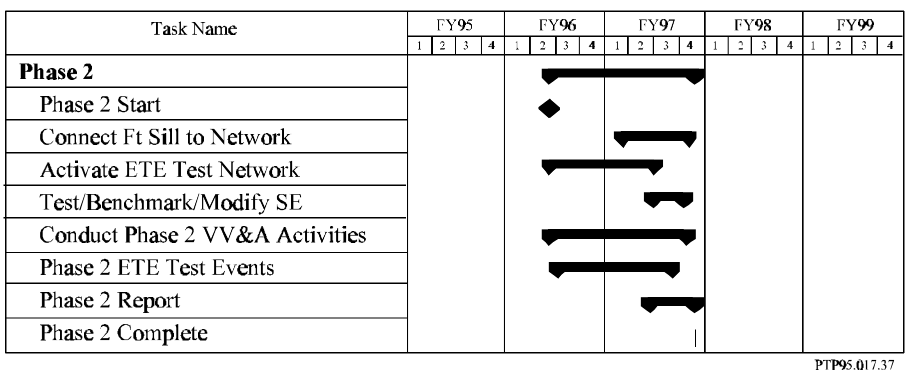

Figure 3-17. End-To-End Test Phase 2 Schedule

3.4.3.3 Phase 3

a) *Purpose*. The purpose of Phase 3 is to provide an iterative step in determining the utility of ADS to the T&E of a C^4I system. This phase will ensure that the RPS functions correctly onboard the E-8C and that the synthetic environment will interact with the aircraft and actual GSM in a proper manner.

b) *Test Scenario*. For the aircraft, this will be accomplished by moving the RPS from the Northrop Grumman Laboratory onto the test aircraft. The stripped Entity State PDUs from the synthetic environment will then be transmitted to the RPS aboard the E-8C, as was done in the laboratory, ensuring compatibility of the RPS with the aircraft and a seamless mix of targets on the actual E-8C operator workstations. Similarly, an actual GSM will be used at Fort Huachuca to ensure compatibility of network hookups and data flow.

Two methods will be used to transmit the stripped PDU data onboard the aircraft while parked on the ramp. The first method will be to use a land line similar to that used in Phases 1 and 2. The second method will be to use the ground-to-air link planned for the live fly missions. Several equipment options for the ground-to-air link are being examined that have already demonstrated technical feasibility. The most appropriate one, based on required bandwidth, will be chosen once the Architectural Design is completed during Phase 1. These options include single or multiple UHF frequencies, large bandwidth digital radio, existing data links such as Joint Tactical Information Distribution System (JTIDS) or Tactical Digital Information Link (TADL-J), or an additional data link provided via a hatch-mounted antenna.

The transmission of the SCDL information between the aircraft to the GSM will use a SCDL Ground Station Transceiver, connected to the GSM by commercial circuits, and the SCDL Transceiver located aboard the aircraft. This duplicates the setup that will be used during Phase 4.

The phase will end with an extensive series of tests, benchmarking, and a re-verification and validation of the synthetic environment. This will then be followed by a re-accreditation of the synthetic environment. This review of the previously conducted VV&A is required because two virtual nodes, the virtual E-8C and the GSMR, have been replaced with the actual hardware. Throughout this phase, data will be collected to be used in answering JADS Issues 1, 2 and 3. A pictorial of Phase 3 is shown in Figure 3-18.

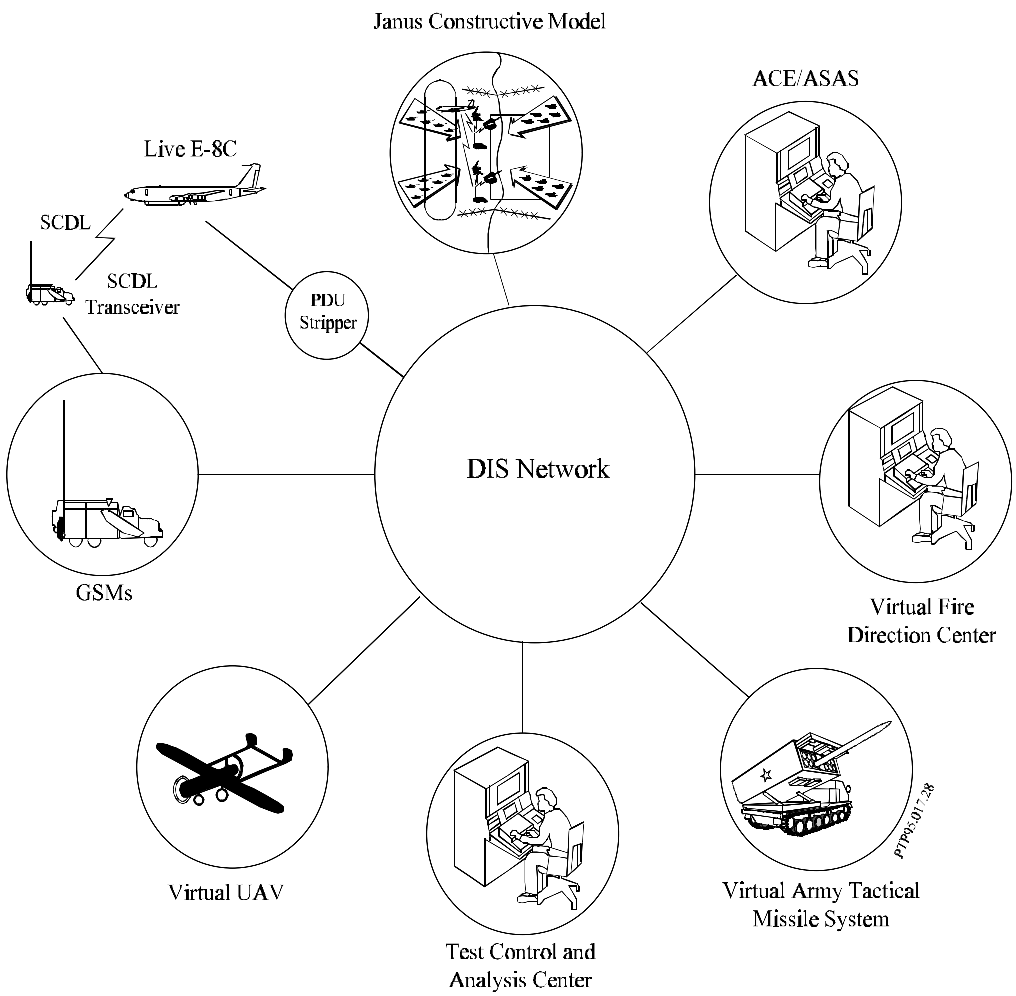

Figure 3-18. End-To-End Test Scenario–Phase 3

c) *ADS Configuration*. The ADS Architecture for Phase 3 is the same as Phase 2 except that the interface unit for the GSMR is moved to connect to a real GSM and the RPS is moved from the laboratory to onboard the actual E-8C. Initial communications with the E-8C will be established by wire link. Once all systems are working, the radio frequency (RF) links will be established and tested. The architecture for Phase 3 is shown in Figure 3-19.

d) *Test Participant Roles*. Phase 3 of the ETE will be accomplished in a joint effort by the JADS JTF, Northrop Grumman, TRAC-WSMR, Fort Sill Battle Lab and the Military Intelligence Simulation Center (MISC). The roles of each are as follows:

JADS JTF

- Overall responsibility for the planning, execution, analysis, and reporting of the test.

- Develops ADS measures and related events.

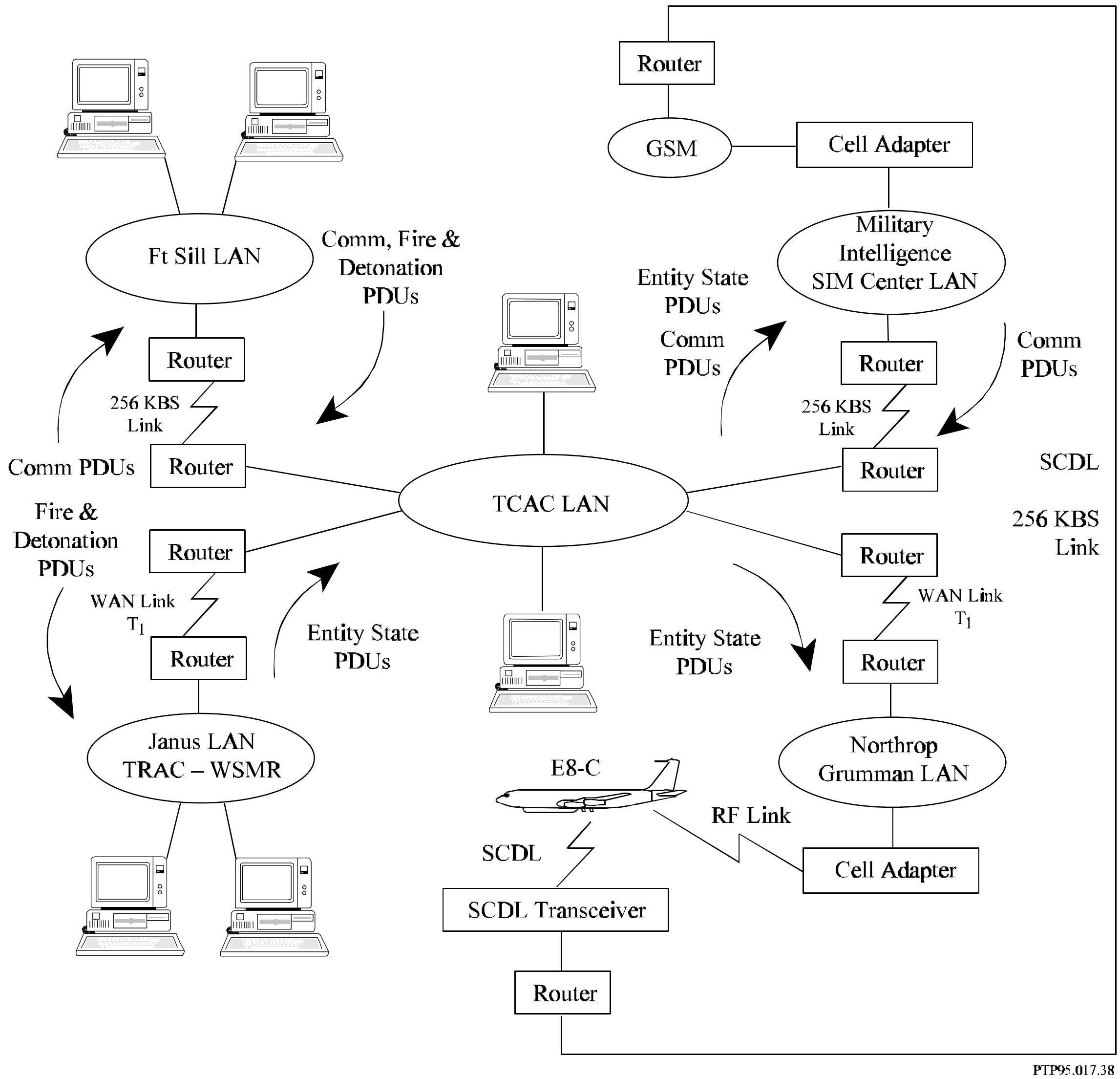

Figure 3-19. End-To-End Test ADS Architecture–Phase 3

- Analyzes and evaluates ADS measures.
- Reports interim and final results to OSD.
- Develops the Phase 3 Test Plan.
- Develops V&V plan for ETE Phase 3.
- Establishes necessary communication links with test participants.

- Activates ETE DIS Network
- Develops necessary scenarios for ETE Phase 3.

Northrop Grumman

- Installs RPS aboard E-8C.
- Tests SCDL between Aircraft and base station with RPS installed.
- Supports activation of ETE DIS Network.
- Supports testing/benchmarking/modification of ETE DIS Network with SCDL active.
- Supports conduct of ETE Phase 3 Events.

TRAC-WSMR

- Supports activation of ETE DIS Network.
- Supports testing/benchmarking/modification of ETE DIS Network with SCDL active.
- Supports conduct of ETE Phase 3 Events.

Fort Sill Battle Lab

- Supports activation of ETE DIS Network.
- Supports testing/benchmarking/modification of ETE DIS Network with SCDL active.
- Supports conduct of ETE Phase 3 Events.

Military Intelligence Simulation Center

- Transfers DIS interface to actual GSM.
- Establishes SCDL with GSM.
- Supports activation of ETE DIS Network.
- Supports testing/benchmarking/modification of ETE DIS Network with SCDL active.

- Supports conduct of ETE Phase 3 Events.

Joint STARS Joint Program Office

- Provide contract support for Northrop Grumman tasks.

- Authorize access to MOT&E data.

e) *Test Tasks*. The schedule of top level tasks and activities for Phase 3 is given in Figure 3-20.

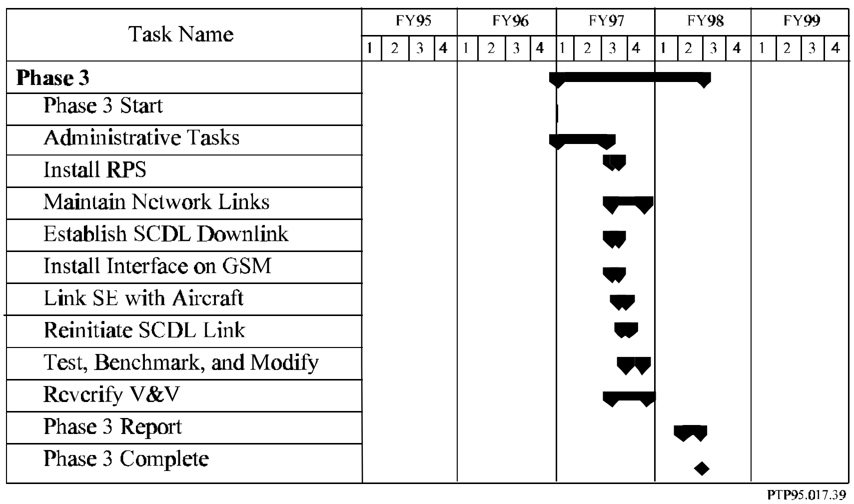

Figure 3-20. End-To-End Test Phase 3 Schedule

3.4.3.4 Phase 4

a) *Purpose*. The purpose of Phase 4 is to determine the utility of ADS in augmenting a live open-air test mission of a C^4I system. ADS will be used, as in Phase 2, to present a synthetic environment that is more representative of an operational theater than would be found at a test or training range. The ETE live test missions will replicate missions flown during the Joint STARS MOT&E, to include the use of typical operators.

Data collected from these missions will be compared with data collected during similar MOT&E live test missions. In addition, the synthetic environment will be closely monitored to collect DIS component performance data, assess the impact of DIS component performance on the SUT data, and identify problems with DIS components and test methodologies which impact SUT data validity. These results will also be used, as appropriate, to help establish requirements for subsequent ADS technology growth.

b) *Test Scenario*. Phase 4 will be accomplished by using much the same synthetic environment, with associated C^2 and weapon system nodes, as was used in Phase 2. The difference is that the SUT (E-8C and GSM) has been substituted for the simulated systems used in Phase 2. An airborne E-8C will observe a live ground exercise, as was the case during the MOT&E. In addition to the live ground exercise, the operators aboard the aircraft and in the GSMs will also see an operationally realistic virtual battlespace surrounding the exercise area. As a result of addition of the virtual battlespace, the operators should be able to realistically interact with both battlespaces, in a seamless manner, and experience a mission task load more representative of a notional corps area. In total, the 300 to 400 real targets normally present in the exercise area will be augmented by approximately 5000 virtual targets. The E-8C and GSM should also be able to interact with appropriate C^4I elements and weapon systems in the synthetic environment, with selected virtual ground targets engaged by a virtual ATACMS and, where appropriate, battle damage assessment should be performed by the E-8C.

To obtain actual C^4I systems and personnel, JADS will leverage off an exercise involving a corps possessing GSMs. A GSM SCDL transceiver will be located at the National Training Center (NTC) for the purpose of receiving SCDL traffic from the E-8C. SCDL traffic will then be transmitted via commercial circuits to the GSMs participating in the test. These GSMs will be a part of an annual III Corps CPX conducted at Fort Hood, TX. These GSMs, plus III Corps operators, will be used during the JADS ETE to send radar mission requests to the E-8C. Additionally, JADS will leverage off actual III Corps command post C^4I personnel and nodes to represent the simulated C^4I nodes represented in earlier phases.

Due to the interactive nature of the synthetic environment, the operator aboard the E-8C, or in the GSM, will observe the gross physical effects of a virtual ATACMS mission. As an example, if a virtual convoy is targeted and hit by a virtual ATACMS, the destroyed vehicles will become stationary, while the remaining vehicles will scatter, flee in panic, or some other similar action. The operator will be able to perform a real-time endgame analysis/damage assessment of the effects of the virtual ATACM.

The same measures that were evaluated during Phases 2 and 3 will be evaluated during this phase. The difference will be that the actual Joint STARS, as opposed to the simulation of Joint STARS used in Phase 2, will be performing missions while enhanced with an ADS generated operationally realistic synthetic environment, that were performed during the MOT&E. The ADS measures will also be evaluated during this phase, as the synthetic environment for this phase is different then the synthetic environment used in Phase 2. A pictorial of Phase 4 is found at Figure 3-21. Note: Figure 3-21 depicts a simulation of, and not the actual, C^4I nodes and links.

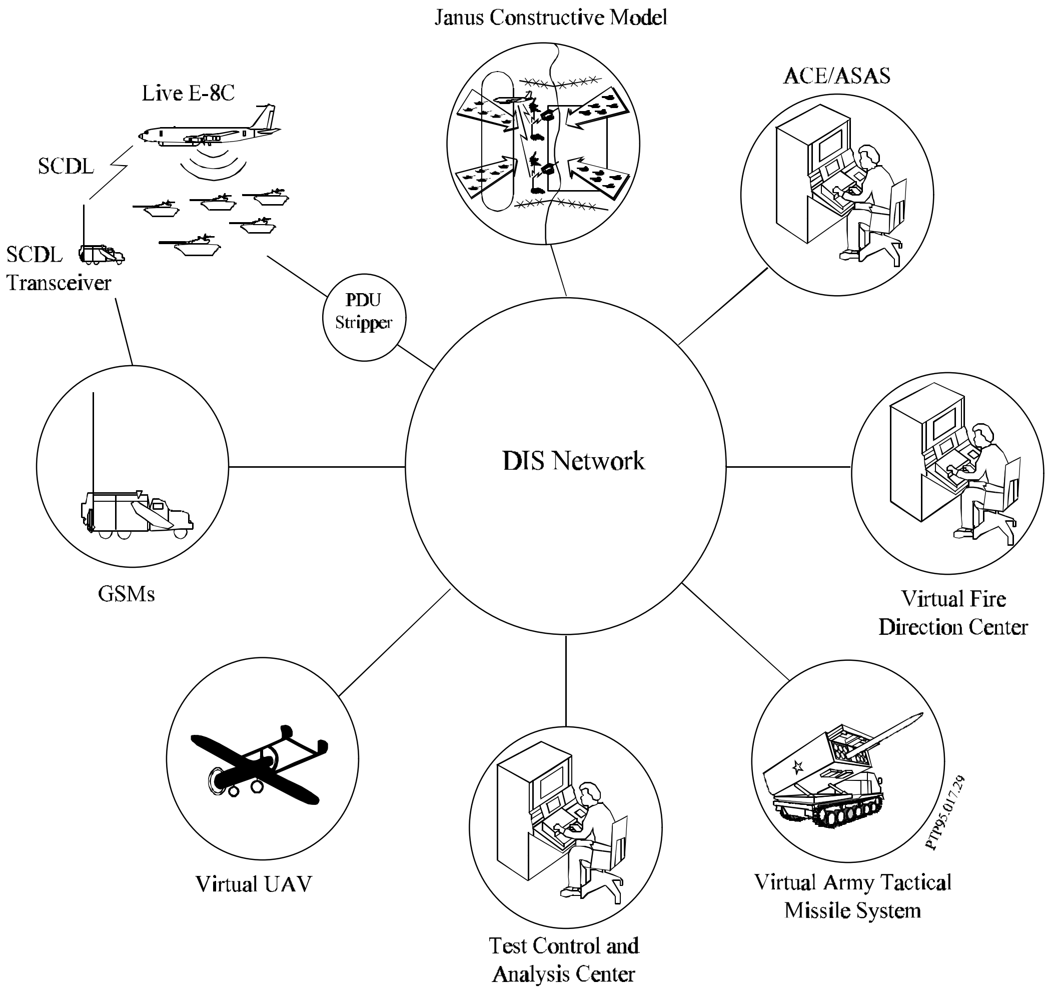

Figure 3-21. End-To-End Test Scenario–Phase 4

c) *ADS Configuration*. The ADS Architecture for Phase 4 is the same as Phase 3 except that the locations of the E-8C and GSM will be different. The E-8C will be flying a real mission during the Phase 4 Test Activity. The GSM(s) will be in support of a corps headquarters. There is also a possibility that the interface with the ASAS will be moved from Fort Huachuca to the ASAS used by the real corps headquarters. The architecture for Phase 4 is shown in Figure 3-22.

d) *Test Participant Roles*. Phase 4 of the ETE will be accomplished in a joint effort by the JADS JTF, Northrop Grumman, TRAC-WSMR, Fort Sill Battle Lab, Military Intelligence Simulation Center (MISC), US Army III Corps, and the National Training Center, Fort Irwin, CA. The roles of each are as follows:

JADS JTF

- Overall responsibility for the planning, execution, analysis, and reporting of the test.

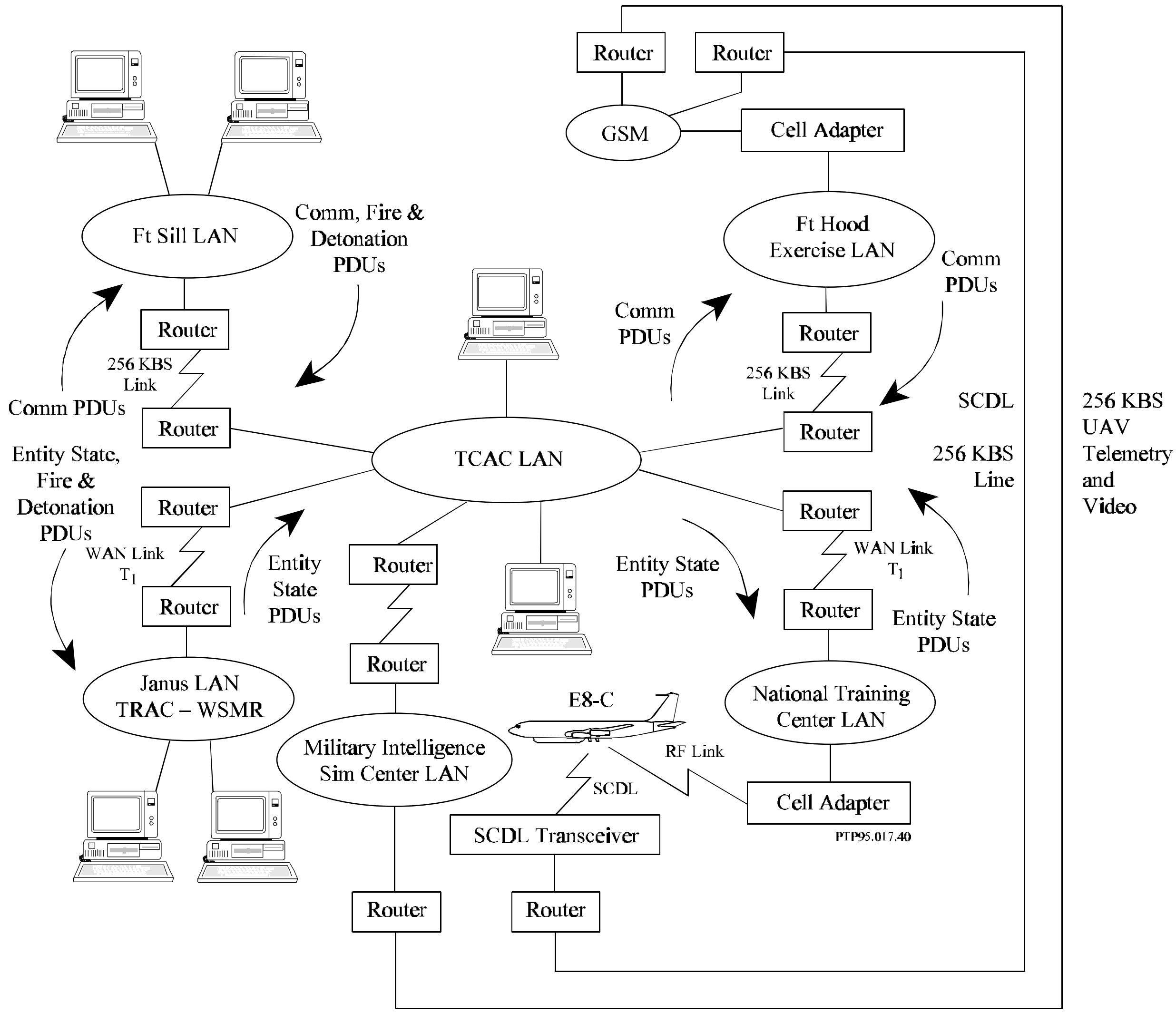

Figure 3-22. End-To-End Test ADS Architecture–Phase 4

- Develops ADS measures and related events.
- Analyzes and evaluates ADS measures.
- Reports interim and final results to OSD.
- Develops the Phase 4 Test Plan.
- Establishes necessary communication links with test participants.
- Activates ETE DIS Network.

- Develops necessary scenarios for ETE Phase 4.

- Coordinates with III Corps with respect to participation in ETE.

- Coordinates with NTC with respect to participation in ETE.

- Coordinates for SCDL downlink to be established at NTC.

Northrop Grumman

- Supports conduct of ETE Phase 4 Events with E-8C.

TRAC-WSMR

- Supports activation of ETE DIS Network.

- Supports conduct of ETE Phase 4 Events.

Fort Sill Battle Lab

- Supports activation of ETE DIS Network.

- Supports conduct of ETE Phase 4 Events.

Military Intelligence Simulation Center

- Supports activation of ETE DIS Network.

- Supports conduct of ETE Phase 4 Events.

III Corps, Fort Hood, TX

- Conducts corps level CPX using assigned GSMs.

- Receives SCDL feed from E-8C.

- Supports conduct of ETE Phase 4 Events.

NTC, Fort Irwin, CA

- Conducts scheduled training rotation.

- Supports establishment of SCDL downlink.

Joint STARS Joint Program Office

- Provide contract support for Northrop Grumman tasks.

- Supports conduct of ETE Phase 4 SUT Test Events.

- Authorize access to MOT&E data.

e) *Test Tasks.* The schedule of top level tasks and activities for Phase 4 is given in Figure 3-23.

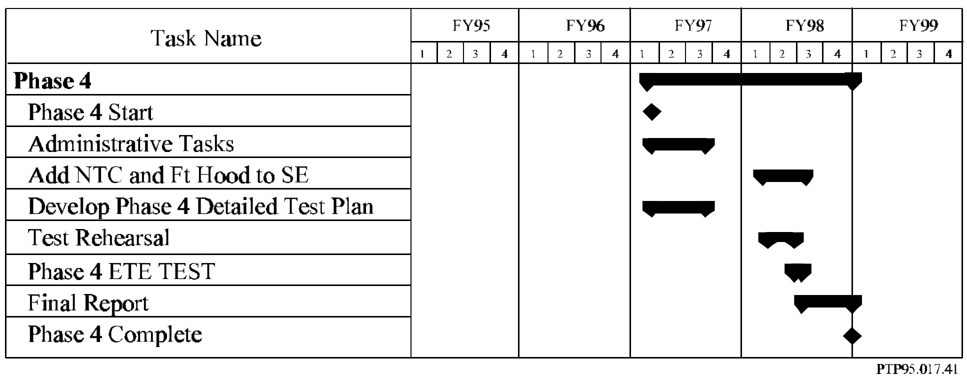

Figure 3-23. End-To-End Test Phase 4 Schedule

3.4.4 Constraints & Limitations

The End-To-End Test has been designed to test the ADS technology. As a result, the technical feasibility of many of the elements of the test will be examined closely. Two elements in particular are especially critical to the completion of the test:

a) The first critical element is the development of the Radar Processor Simulation (RPS) and its interface with the E-8C. The mixing of simulated terrain and entities with real terrain and real entities as a part of a radar return, in a seamless and realistic manner, has not been previously attempted. Previous efforts have involved the simulation of MTI radar returns, with all the terrain and entities simulated, or the addition of simulated entities to real terrain and real entities. The real time production of SAR images containing both simulated terrain and simulated entities has also not been tried, nor has the logical interweaving of these simulated images with real SAR images. In addition, the RPS must interface with the E-8C, receiving both missions for its radar simulations and aircraft state data so that the simulated radar returns appear real. Because this element is so key to the End-To-End Test, and must be accomplished before the test may proceed, it is the primary effort in Phase 1. Failure to develop the RPS will require major revisions to the End-To-End Test as presently designed.

b) The second critical element is the radio frequency (RF) link used to transmit entity state data from the ground connection to the E-8C while in flight. Though ground to air data links have been previously used, the sheer volume of data required to be passed makes this a challenging problem. Failure to satisfactorily establish this RF link will prevent the aircraft from obtaining the real time, synthetic entity state data required for the RPS to generate virtual radar returns. Fortunately, this RF link is not needed until Phase 3. Failure to develop this RF link will still allow the first two phases of the End-to-End Test to be completed and the ADS and SUT measures to be evaluated.

c) Other constraints and limitations are associated with the Joint STARS operational environment. It is impossible to replicate the full Joint STARS operational environment. The nature of the RF uplink to the aircraft places a limitation on the number of entities that can be added to the operational environment. For these reasons, the limit of approximately 5000 entities has been placed on Janus. It is believed, however, that though still far short of the operational environment, the increase in the number of battlefield targets by an order of magnitude will suffice to enable JADS to evaluate whether this ADS application is worthwhile.

d) A final constraint is that no communications jamming will be played.

3.4.5 Program Feedback

Besides addressing the JADS issues, objectives, and subobjectives, the ETE will also provide several other inputs to the JADS JT&E. The ETE will provide documented examples of the implementation of DIS practices and procedures, such as the "DIS VV&A Process", which can be used to develop training materials for future users of ADS in support of a test.

The results of the ETE will also be extended to the class of C^4I systems for use by other testers.

3.5 ELECTRONIC WARFARE TEST

This section is reserved for the Electronic Warfare test. This PTP will be amended to include this section after the Electronic Warfare test is approved.

3.6 OTHER ADS ACTIVITIES

In addition to the two specific test activities (SIT and ETE) that make up part of the JADS JT&E, the JADS JTF has been tasked to research, observe, participate in, collect data on, and report on other test activities using ADS technologies.

3.6.1 Description

The JTF needs to collect more data than the specific JADS tests will deliver in order to make broader conclusions on the utility of ADS to the entire spectrum of T&E. The two specific tests will collect data that will be extrapolated to conclusions about general classes of systems of which these two systems are representative. In order to “fill in” the holes of the utility of ADS for classes of systems for which the JT&E did not have specific test actions, the JTF will pursue other ongoing ADS activities.

3.6.2 Issues, Objectives, And Measures

3.6.2.1 Issue 1: Utility of ADS

Results from other ADS test activities will be examined against the JADS objectives for Issue 1. Baselining and V&V activities associated with all of these programs will be requested and folded into the discussion of the validity of data collected in an ADS environment. Additionally many of these activities are technology demonstration programs and will be used to determine the utility of ADS in the early acquisition phases. Monitoring these other activities is vital since they will be the only source of information about ADS in support of early acquisition phases (JADS Subobjective 1-2-1). Additionally, other test activities will help to give higher confidence in estimating the costs associated with implementing ADS.

3.6.2.2 Issue 2: Constraints, Concerns, & Methodologies When Using ADS

Again, other ADS test activities will assist us in assessing the objectives of Issue 2. Network analyses and reliability information should be readily accessible from final reports on these activities. Additionally, the planning, execution, analysis, and VV&A methodologies employed by these other ADS activities will be assessed for inclusion in the JADS final report.

3.6.2.3 Issue 3: Requirements & Recommendations

The lessons learned from all ADS test activities will assist the JADS JTF in making quality recommendations of what needs to be done for the T&E infrastructure in order to take advantage of ADS techniques.

3.6.3 Test Activities

3.6.3.1 Survey Of Other Activity

A survey of all ADS T&E activity is being conducted. Systems that are currently using ADS for T&E that will be leveraged are the Anti-Armor Advanced Technology Demonstration (A^2ATD), the Joint Advanced Strike Technology (JAST) program, the Virtual Test and Training Range (VTTR) initiative, the Maritime Synthetic Test Range program, the High Level Architecture (HLA) initiative, and the Army Tactical Command and Control System (ATCCS). JADS participation in these activities will only be limited by the activities themselves. Memoranda of Agreement with all of these activities will be developed to gain agreement to allow the JADS JTF access to their tests. Additionally, JADS JTF members will attend various professional symposia in order to gather information on all types of ADS activities.

3.6.3.2 Data Collection

The JADS JTF will seek copies of all formal test plans and reports from these activities; plus seek permission to administer our JADS questionnaires and interviews to participants in these activities. Additionally, we will request permission to participate in their activities either as an on-site observer, using our stealth node, or in an advisory capacity if desired.

3.6.4 Constraints & Limitations

The largest obstacle in collecting this data from other ADS activities is the large amount of work already being done in this area. The process of gathering this data and incorporating it into our results will make significant demands on our resources (personnel and funding).

3.6.5 Program Feedback

All of the data gathered from other ADS activities will be folded into the results from the two JADS specific test activities and presented to a group of T&E experts to support our conclusions regarding the three JADS Issues.

4. VERIFICATION, VALIDATION, AND ACCREDITATION

4.1 BACKGROUND

4.1.1 JADS VV&A Philosophy, General

JADS will perform two tests that use ADS. The same VV&A procedures will be applied to both testing programs, but differences in the simulation and network procedures used will result in individual VV&A plans. Each detailed VV&A plan will be part of each TAP. The ADS VV&A Plans will be used in planning and executing the two tests. This will wring out the plans and provide a legacy of lessons learned that may be applied to future plans.

Cost-effectiveness and the subsequent need to examine a model on as high a level as possible will be the cornerstones of the ADS VV&A Plan. The plan will outline methods for selecting a cost effective level of VV&A.

4.1.2 Unique Characteristics of ADS VV&A for T&E and JADS VV&A

The testing demands on ADS are generally more stringent than training demands. For example, testing's need to control test activity is considerably more demanding than training's need to monitor training activity. Also, realism and fidelity requirements to achieve credible testing for DoD and industry are also more demanding than for training. From a VV&A standpoint, unique characteristics of ADS in its application to T&E are the following:

Previous VV&A policies and procedures have been developed primarily for constructive models. ADS applications which integrate live, virtual, and constructive players create unique VV&A challenges requiring new or modified policy and/or procedures.

JADS VV&A is strongly interactive with the test objectives themselves. A number of the measures talk to fidelity, or lack thereof, and how that fidelity impacts results. Computing and combining these measures to answer test objectives are test results. This is fundamentally different than typical VV&A accomplished prior to test start. In fact, the utility of ADS for T&E is founded upon ADS's ability to provide valid data, and the valid data themselves are dependent on verified and validated tools.

JADS is evaluating a test methodology. If, for example, the JADS SIT yields results comparable to previous non-ADS tests, the JADS methodology would be considered credible. Also, these results would tend to independently verify and validate JADS tools.

The focus of the JADS VV&A efforts will be on the VV&A of networked configurations. JADS will rely on the previous VV&A work performed by the organizations responsible for the component simulations participating in JADS. Where past VV&A efforts for these simulations may not have been satisfactory for JADS applications, JADS will conduct VV&A within resources and as required to ensure creditable insights can be drawn from ADS tests.

4.1.3 Importance of VV&A

There is tremendous DoD and even General Accounting Office interest in the topic of VV&A. One major reason for such interest is an explosion in the military use of M&S. Major decisions and the analysis backing such decisions, including COEAs, are increasingly based on M&S results. Because of these factors, there is an increase in attention to and regulation of VV&A of M&S. Also, appropriate VV&A requirements should provide a forum and a language to foster communication among analysts, testers, and decision makers to help ensure relevant, usable results, and, in the long run, facilitate improved simulation quality.

Most DoD regulations address DIS rather than ADS. For the purposes of this JT&E, it is assumed that discussion about DIS applies to ADS.

4.2 ADS VV&A

4.2.1 Regulations and Policies

JADS will employ networks which can be termed a "federation" of individual models. Therefore, the JTD must accredit such networks IAW DoD Regulation and Instruction 5000.59. Even though the JADS test results are not intended to support acquisition decisions, nor are the JADS decision processes "major" as defined by the regulation, the network itself and each node or element of the JADS tests and other simulation networks must be accredited. Individual elements of distributed simulations shall be verified and validated by node owners IAW their component (service) policy because, as summarized in DoD Directive 5000.59, (DoDD5000.59) "Each DoD component shall be the final authority for validating and accrediting representations of its own forces and capabilities in joint and common use M&S applications" (including scenarios).

In summary, the JADS JTF will accomplish VV&A of the network and elements thereof by employing, as much as possible, node owner’s verification and validation of individual nodes. This "Joint VV&A" for T&E should help the services to agree on VV&A policy in the long run. Such agreement should be of general benefit, particularly with the increasing use of ADS.

Heritage for this plan can be easily found in Service VV&A regulations and in the Susceptibility Model and Range Test (SMART) literature.

4.2.2 JADS VV&A Constraints and Limitations

JADS has limited resources. Therefore, JADS intends to employ a "cost-effective" amount of VV&A. As will become apparent, JADS may exercise the option to jump to accreditation after only partial V&V. In some cases, the logic for taking this jump would be to avoid additional cost and schedule slips.

Also, the more detailed V&V could be accomplished at a later date, in some cases, using information from JADS tests. Precedent for this methodology can be found in the DMSO draft methodology handbook which says: "Hence accreditation is possible even if the model is not exhaustively validated. However, accreditation does not lessen the need for continuing to work toward full V&V."

4.2.3 Policies, Guidelines and Priorities

The following provide a summary of the policies, guidelines, and priorities for ADS VV&A activities:

- Build on previously accomplished work.
- Focus on important players. Focus on how they play in JADS.
- Capitalize on the judgment of the operators (normally military) who have employed the actual systems and have also used the simulation nodes (or entities). For individual systems, capitalize on the knowledge base of subject matter experts.
- Employ cost-effectiveness as a criterion to decide whether a fix is needed. The level of cost effectiveness is test specific and purpose dependent.
- Try for "effects level" (sometimes called "face value") validation wherever possible.
- VV&A for the life of the test as continuous process improvement.
- Try to share costs of VV&A and required changes with the individual simulation sites on a fair and equitable basis.
- Review services' models within each service's guidelines.
- Tailor DIS/DMSO effort for JADS.

4.3 JADS VV&A ORGANIZATION

JADS will employ a V&V Working Group (VVWG) to implement the verification and validation processes within the context of the individual simulations associated with test phases and produce evidence that will be presented to the Accreditation Board (AB). The AB will review the evidence and make a recommendation to the Joint Test Director. The VVWG and the AB together will be called the "V&V Team."

Membership on the VVWG will vary as a function of the issues at hand. It will always include subject matter experts and government members with operational expertise. It will be augmented with members from the public and private sectors with expertise at the other half of the equation which is the expense and technical feasibility of increases in fidelity.

The Joint Test Director will make the final accreditation decision. His signature on the final report or any interim product indicates that he accredits the network and the nodes, and, therefore, that the individual models were acceptable and used appropriately for the specific purpose for which they were employed.

4.4 JADS METHODOLOGY: HOW TO VV&A AN INDIVIDUAL NODE

So far, this section has made general statements which address both VV&A of the network and VV&A of the nodes or individual systems which are part of that network, for example the Joint STARS emulator or simulator. Next, a clear split will be made, and VV&A of an individual node will be addressed. Later, VV&A of the entire network of nodes together will be addressed. As stated in AFI 16-1001, ". . . Each component M&S for inclusion in the distributed architecture would be identified and separately VV&A'd for intended DIS usage. The entire distributed architecture is then assembled and V&V'd as a single entity . . ."

4.4.1 Existing vs. New Simulations

Most of the simulations that JADS is examining for the SIT and ETE are, at least in part, existing and established. Therefore, some V&V can be judiciously avoided. If, for example, a new Joint STARS simulator or emulator is developed, some V&V will occur before JADS, and the V&V team will build on that work. JADS will focus on that which is unique to ADS. For example, in the SIT, most of the systems have been used before. However, previously, target position data had been fed to the GWEF via batch files. JADS will focus on methodologies for entering real-time data.

4.4.2 Building an Accreditation Support Package

Figure 4-1 is the outline of JADS' VV&A methodology for individual nodes.

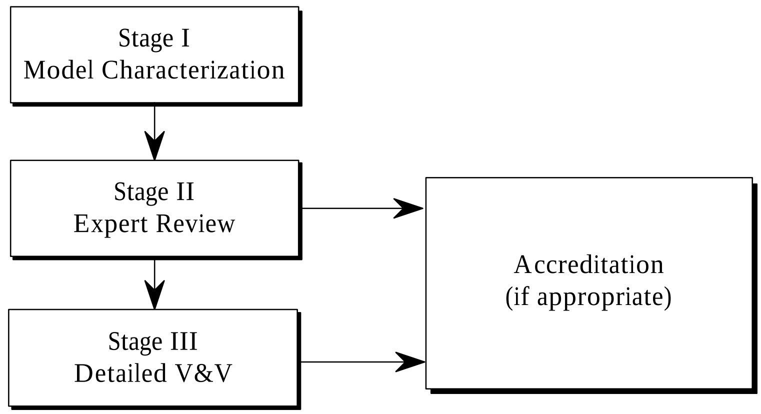

Figure 4-1. JADS Accreditation Support Package Plan

4.4.2.1 Stage I, Model Characterization

During Stage I of the VV&A, the V&V team will:

- Read all of the VV&A literature at the site of the model and ask appropriate questions.
- Read other literature on the model, if time permits.
- Administer a questionnaire, model by model (although in some cases a number of models can be aggregated at one site.) Use at least the following questions:
  - Who has used your model?
  - To what end?
  - Who has accepted the results?
  - Who has accredited the model before and for what purposes?
  - How well is the model documented?
  - How good is the software?
    - How has the quality of the software been evaluated?
    - What are your configuration control policies, procedures, and practices?
    - What is the model's V&V history and status?

- What model assumptions, limitations, errors and approximations are known?

The V&V team will use the answers to quickly characterize each simulation as well managed and well maintained whose limitations are known, or less well managed and, therefore, prone to higher risk. The team will then enter the answers into an accreditation support data base. They will also develop a feel for the quality of the model and where to look for soft spots. A long history of high-level users, for a variety of uses (e.g. requirements refinement, COEAs, and training) is a meaningful plus that is difficult to quantify but clearly adds credibility. This first look is supposed to provide to the team a general "feel" for the model, model maintenance, and model credibility. The V&V team will take a particularly hard look at new, developed for JADS components such as the AASI, even when such components are not “models,” per se.

The plan does not allow the V&V team to make an immediate jump to accreditation no matter how much credibility is judged at this stage. The team will proceed to Stage II variants in each case.

4.4.2.2 Stage II, Expert Review

In this stage, the V&V team will question subject matter experts. "Experts" are operators who have used the model and also the real system and perhaps have other skills and judgments which can be tapped. The basic criterion for the human-in-the-loop systems is as follows: Is the simulation operator (sensor, attack system, etc.) subject to approximately the same operating environment as the real operator within the context of the mission of the system under test? Sometimes the site maintains a history of the fidelity complaints of operators who have used the entity. In this case, the team will read that file. They will concentrate on open "change requests" or whatever the individual site calls such an item. The site may have decided to not fix the operator's complaints for well-thought-out reasons (e.g., too expensive to fix, presses state-of-the-art to fix, or the owner just decided that it is OK as is for the general purposes of the site). At the end of this stage, the team should have a very well-formed notion about node fidelity.

For some special cases such as the hardware emulator in the GWEF, the system is not human-in-the-loop, and the questions will be rephrased for pure hardware and subject matter experts. If appropriate, the team will recommend accreditation of the individual model to the Accreditation Board at this point.

4.4.2.3 Stage III, Detailed Verification and Validation

The JTF intends to require this detailed verification to be accomplished only when appropriate due to resource constraint. Detailed verification means actually examining code or at least code modules. This examination means desk checking and software testing of the code, when appropriate, at the subroutine level, ideally by employing CASE tools in order to confirm that the model implementation accurately represents the developer’s conceptual description and specifications.

Then, if appropriate, the V&V team will validate the model in order to determine the degree to which the model is an accurate representation of the real world from the perspective of JADS’ intended uses of the model.

4.4.2.4 Summary

In summary, the VVWG will:

- Summarize all errors and inaccuracies for the accreditation board.
- Recommend one of the following options to the accreditation board for each defect:
  - Defect is minor, document it and continue.
  - Defect is major and should be fixed with verified and validated changes.
  - Defect is major. However, results can be caveated appropriately.
- Recommend accreditation of each individual node.

4.5 JADS METHODOLOGY: HOW TO ACCREDIT AN ADS T&E NETWORK

So far, this section has addressed the VV&A of the individual entities, nodes, or elements which simulate, in general, individual systems which will play in JADS. Once this is accomplished, JADS will accomplish VV&A of the network of all of the nodes together and their interactions. The process for VV&A of the ADS network itself is taken directly from the DMSO/DIS plan as modified for non-DIS compliant ADS when appropriate, and as shown in Figure 4-2. This nine-step VV&A approach is based on the Standard VV&A Process Model IAW the Draft Implementation Guide for VV&A of DIS, September, 1995.

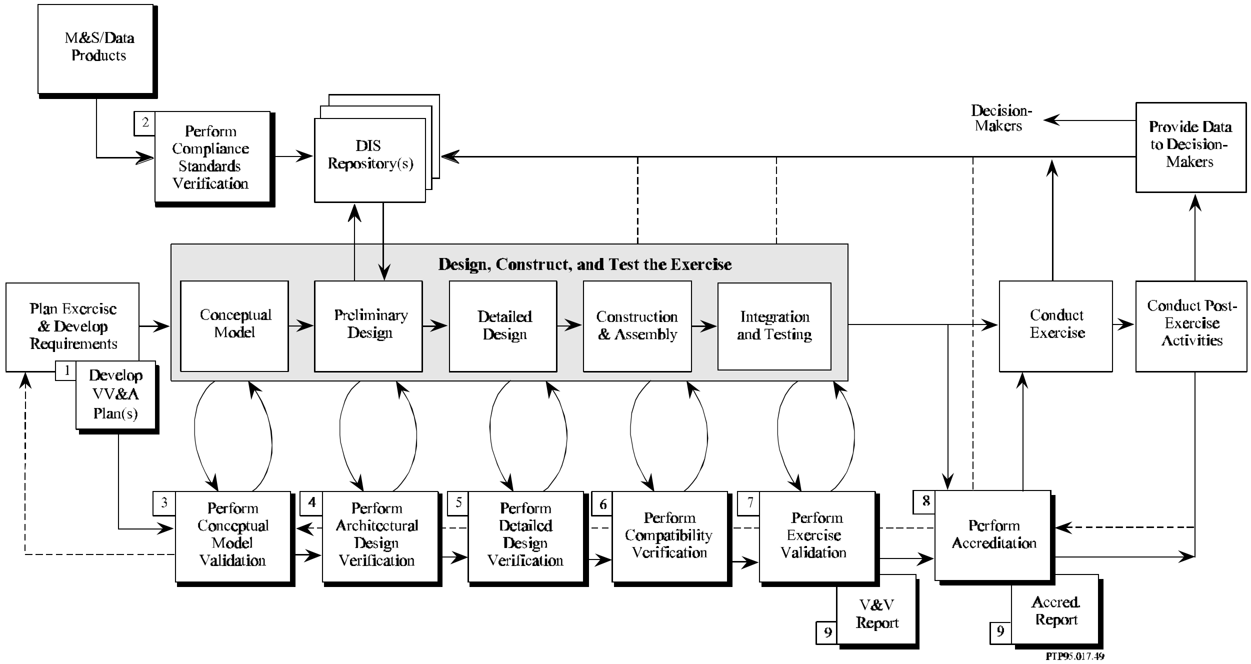

Figure 4-2. VV&A Process Model

Emphasis will be placed on the validation step, and in particular, a comparison of results from JADS tests with previous tests that employed live field testing for each SUT. For the SIT, an extensive data base of results from previous AMRAAM flights is available for validation. For the ETE, field test data are dependent upon completion of the Joint STARS MOT&E or the collection of Joint STARS performance data without the employment of virtual targets during ETE Phase 4.

The JADS V&V team will, as in the node-by-node accreditation, capitalize on the peculiarities of ADS as employed by JADS and build on past V&V activity. It will employ the nine-step methodology as a checklist. “Checklist” implies that each item is meant as a reminder to consciously decide if a particular step is appropriate and to employ, only if appropriate, in the appropriate amount of detail from the implementation guide. For example, a Compliance Standards Verification would be required for the DIS version of JANUS, but the V&V team would merely confirm that such a check was previously accomplished. Similarly, for some of the telemetered data of the SIT, and, possibly, for some of the position data, DIS standards will not be met, so a Compliance Standards Verification, per se, would not literally make sense. However, insuring that the GWEF expects the same data standards and protocols that the target aircraft will send is appropriate. Similarly, as part of a usual DIS exercise, the Architectural Design Verification step and other steps are designed to insure that the bandwidth of the communication links between nodes is large enough. That is the bandwidth must be broad enough to insure that only a small percentage of PDUs will be lost in “worse case” scenarios of entities making rapid entity state updates. However, for most of the SIT, position updates (of, say, shooter, target, and missile) will occur at a steady rate, not irregularly as acceleration thresholds are crossed. Therefore, the normal capacity checks must be accomplished. A reminder to accomplish such checks is appropriate, but such checks would be tailored for the SIT's specific needs.

The literature strongly recommends that Integration and Testing steps are to be accomplished as an incremental process. In the spirit of this recommendation, both JADS' SIT and ETE are accomplished in phases with a natural incremental buildup of number of components and connectivity. The V&V team will perform V&V on the interface units and the interfaces to each participating component. Then the V&V team will perform V&V of the integrated synthetic environment as the components become interoperable. The development approach for JADS is to integrate and test one component at a time, then examine the interactions between components, and finally fully test the interoperability among the components. The JADS V&V team will participate in all of these activities throughout the multiple phase development program and will increase its test involvement as the integration is able to demonstrate the interactions between components.

In summary, the JADS JTF will accomplish VV&A to a cost-effective level. It will evaluate individual models on as high a level as possible. The JTF will depend on individual node owners to accomplish some V&V, and it will build on their work. Lastly, the JADS JTF will concentrate on VV&A of the network of models that it assembles for each individual test.

5. ANALYSIS APPROACH

This section describes planned analyses for JADS test issues. An overview of the analysis structure planned to address test issues is given first. This overview is followed by the planned analysis methods for each objective. And finally, the strategy for combining results of individual JADS tests is summarized.

5.1 ISSUES AND OBJECTIVES

The issues and objectives are summarized in Table 5-1.

Table 5-1. Issues and Objectives

Issues	Objectives
Issue 1: What is the present utility of ADS, including DIS, for T&E?	Objective 1-1: Assess the validity of data from tests using ADS, including DIS, during test execution. Objective 1-2: Assess the benefits of using ADS, including DIS, in T&E.
Issue 2: What are the critical constraints, concerns, and methodologies when using ADS for T&E?	Objective 2-1: Assess the critical constraints and concerns in ADS performance for T&E. Objective 2-2: Assess the critical constraints and concerns in ADS support systems for T&E. Objective 2-3: Develop and assess methodologies associated with ADS for T&E.
Issue 3: What are the requirements that must be introduced into ADS systems if they are to support a more complete T&E capability in the future?	Objective 3-1: Identify requirements for ADS systems that would provide a more complete T&E capability in the future.

The utility of ADS for T&E is founded upon its ability to provide valid data during test execution. Thus, the first step of the analysis (Issue 1, Objective 1-1) is to determine whether or not (or, perhaps, to what degree) ADS provides valid data during test execution. Following this determination, the second step of the analysis, assessing the benefits of ADS to the various aspects of T&E (Issue 1, Objective 1-2), can be accomplished effectively. The second issue addresses anticipated limitations in the application of ADS to T&E, and the third issue addresses what requirements must be introduced in order to support a more complete T&E capability in the future.

The test design, developed by the JTF, applies ADS methods to two specific tests that have DT and OT aspects. The general analysis method will be to compare data from these tests (that use ADS) to baseline data from equivalent previous testing that did not use ADS. System under test (SUT) experts will assess the impact of differences in test conditions (between ADS and baseline tests) on the quantitative comparisons.

The test design provides data in areas of interest while minimizing test costs. Areas of interest were defined in terms of weapon system classes, and ADS potential benefits to current testing. Test costs were minimized through the review and use of previous and planned service test programs. Two planned tests were found that could serve as the baseline for the JTF testing, and from which the JTF could leverage planned testing to satisfy JADS test issues. The two tests are the SIT using AMRAAM and the ETE using the Joint STARS. These tests include developmental and operational testing.

Additionally, the JTF will use data from other T&E-related ADS activities, as appropriate, to flesh out the issues and objectives. Three such activities that may provide ADS T&E utility data have been identified at this time. They are the Army Tactical Command and Control System (ATCCS), the Anti-Armor Advanced Technology Demonstration (A2ATD), and the Joint Advanced Strike Technology (JAST) Program.

5.2 ANALYSIS METHOD

The analysis methods that follow will use specific ADS test data to establish the validity of test data for tests that use ADS. After data validity from tests utilizing ADS is established, subordinate objectives and issues that relate to other aspects of ADS utility in T&E will be addressed.

Quantitative methods will be used to establish data validity, i.e. JADS test data will be compared to comparable non-ADS baseline test data.

Quantitative data are available for baseline AMRAAM (DT tests and Follow-on Evaluation II) and Joint STARS (MOT&E) along with the quantitative criteria and threshold from the TEMPs. The ADS version of the AMRAAM test (i.e., SIT) and Joint STARS tests (i.e., ETE) will generate similar quantitative data. In order to assess the quality of ADS data, the quantitative characteristics of the baselines and ADS versions will be compared to provide inputs to a qualitative assessment of the validity of ADS data.

The impact of differences in test conditions upon the data comparisons will be assessed using SUT tools and experts, so that a quantitative comparison can be accomplished, and remaining differences attributed to ADS or other test factors. For example, for the SIT, the baseline will be established by running the GWEF post test with smoothed inputs for the shooter and target positions and attitudes. Since the GWEF model has been validated for the comparable live fire test, i.e. the GWEF replicated the live fire test data when it was given the smoothed shooter and target data for the live fire, it can be used to create the needed, identical test conditions, baseline data.

The benefits of ADS to T&E will be determined by quantifying benefit of demonstrated and potential changes to the test process and assessing the impact of those changes.

The JADS tests have been designed to demonstrate the utility of ADS to T&E if they can be successfully executed. Regardless of the success of the tests (in terms of execution), significant data will be collected to identify constraints and concerns when using ADS in T&E as well as future technological requirements for improving the utility of ADS to T&E. Again, focused groups of subject matter experts will be used to develop insights based on collected data.

The analysis methods that will be used by the JADS test team to address subordinate issues fall into the general category of descriptive statistical methods.

Additionally, since a key characteristic of ADS is its "distributed" architecture, the JTF plans to evaluate network systems and their capability to support ADS T&E requirements.

The following paragraphs describe specifics of the analysis methods. The structure of the following is to present the planned analysis method for each objective. To assist the reader in understanding, measures and a description of the measures that will be used are also provided. However, it is expected that these measures will be improved and expanded upon as test details are developed. Table 5-2, found at the end of this section, lists the current JADS issues, objective, subobjectives, and measures.

5.2.1 Objective 1-1: ADS Data Validity Analysis Method

The analysis method that will be used for Objective 1-1 is a comparative analysis method. This method will utilize both quantitative and qualitative techniques to analyze the data collected in the tests.

Since the utility of ADS is keyed to ADS data validity, it is important to define what constitutes valid data. Valid data are timely, accurate, reliable, and otherwise faithfully represent real systems. The term "otherwise faithfully represents" is intended to apply primarily to dynamic display/visualization aspects of ADS where human sensory perception is involved and specific parameters to define fidelity are not clearly available. Timeliness, accuracy, reliability, and "fidelity" are the data quality metrics that are used to evaluate data validity.

These data quality metrics will be used in the quantitative evaluation of data validity for ADS test data. To the extent possible, criteria for these metrics will be developed by the SUT analysts in concert with JTF analysts. It is also important to note that the term "SUT data" refers to all test data required to accomplish the SUT evaluation, i.e. it does not refer only to the data obtained from SUT item instrumentation. In general, the data whose validity is to be established is that data used to address the SUT issues. Test data for validity will be collected for inferential statistical treatment. The descriptive statistical methods planned will display metrics that demonstrate the quality of the ADS collected data. The validity of other data, such as that used to verify proper instrumentation function, etc. is a part of the ADS concerns and constraints evaluation.

When a qualitative evaluation of data validity is necessary, the opinions of test participants and test data analysts will be obtained. These personnel will be involved in the analysis of the SUT test data. Through their experience with analysis of non-ADS SUT test data, they will "recognize" differences between ADS and non-ADS data. The existence of these differences will be captured as well as opinions regarding the degree to which these differences perturbate test data or test results.

JADS test team personnel will design, develop, and administer questionnaires and interviews for the collection of the qualitative data whenever questionnaires do not exist from previous non-ADS tests. The questionnaires will have open-ended questions to capture specific information that provides context for qualitative judgement data recorded using a rating scale.

The measures that have been defined for this objective are shown in Table 5-2.

5.2.2 Objective 1-2: ADS Benefits Analysis Method

This objective has been broken down into the following subobjectives:

> Subobjective 1-2-1: Assess ADS capability to support the early phases of the acquisition process;
>
> Subobjective 1-2-2: Assess ADS capability to support T&E planning and test rehearsal; and,
>
> Subobjective 1-2-3: Assess ADS capability to support T&E execution.

The analysis method that will be used for each of these subobjectives is to (as much as possible) conduct activities in the planning and execution of the JTF tests using ADS that may be compared to activities in each phase of a typical T&E program. In this way, the JTF will obtain experiential, lessons-learned data that will illustrate the benefits of ADS. Also, expert opinion regarding other non-tested, anticipated benefits will be collected from T&E experts. The JTF will also collect and use data from other service tests that use ADS technology as appropriate to address this objective.

A structured questionnaire will be developed and administered by JTF analysts. It will include rater comments to justify the benefit rating. These comments will provide analysts with needed insights into factors impacting ADS utility.

5.2.3 Objective 2-1: Performance Constraints and Concerns Analysis Method

This objective has been parsed into the following three subobjectives:

> Subobjective 2-1-1, Assess player instrumentation and interface performance constraints and concerns;
>
> Subobjective 2-1-2, Assess network and communications performance constraints and limitations; and,
>
> Subobjective 2-1-3, Assess the impact of ADS reliability, availability, and maintainability on T&E.

For the first subobjective, the analysis method will be to collect and categorize data from the JADS test activities regarding instrumentation and interface performance constraints and concerns experienced. A particular focus will be on the ease or difficulty of implementing live, virtual, and constructive entities.

The second subobjective focuses on constraints and concerns regarding the ADS network. A major concern regarding ADS for T&E is the communications network capability and availability for testing. These concerns can be expressed both in terms of requisite bandwidth for a given test as well as availability of a given network system due to scheduling and/or reliability of all of the various components that will go together to comprise an ADS test. For this reason, a major focus of the JTF analysis will be on the communications network.

For this subobjective, two analysis methods will be used. One method will be to compare predicted performance to actual performance. The other method will be to provide descriptive statistics of the network characteristics and to explain anomalies that were noted.

Existing network analysis tools will be used to capture network activity during test execution. The network analyzer package will be used to investigate delays, queuing, and other bandwidth-related phenomena. Anomalies will be noted and investigated on a case by case basis. Extraneous traffic will be investigated to ensure that network hardware is performing efficiently. Actual network performance will be compared to predicted performance. JT&E test team personnel will perform all JADS network analysis.

For the third subobjective, the focus is on ADS systems reliability, availability and maintainability and their impacts upon T&E. The analysis method used will be to develop descriptive statistics of the impact of ADS reliability, availability, and maintainability on the test program.

5.2.4 Objective 2-2: ADS Support Systems Constraints and Concerns Analysis Method

This objective has been parsed into the following two subobjectives:

> Subobjective 2-2-1, Assess the critical constraints and concerns regarding ADS data management and analysis systems; and,
>
> Subobjective 2-2-2, Assess the critical constraints and concerns regarding configuration management of ADS test assets.

The analysis methods that will be used for these subobjectives are to collect experiential data on support system constraints and concerns as the JADS tests are executed as well as to conduct an expert opinion survey regarding potential concerns and constraints for other T&E areas.

5.2.5 Objective 2-3: ADS Methodology Constraints and Concerns Analysis Method

This objective has been parsed into four subobjectives as follows:

> Subobjective 2-3-1, Develop and assess methodologies associated with test planning for tests using ADS;
>
> Subobjective 2-3-2, Develop and assess methodologies associated with test execution and control for tests using ADS;
>
> Subobjective 2-3-3, Develop and assess methodologies associated with data management and analysis for tests using ADS; and,
>
> Subobjective 2-3-4, Develop and assess methodologies associated with verification, validation, and accreditation (VV&A) for tests using ADS.

The analysis method that will be used for each of these subobjectives is to document the method(s) developed and to report on its (or their) relative effectiveness.

5.2.6 Objective 3-1: ADS Requirements Identification Analysis Method

The analysis method that will be used for Objective 3-1, Identify requirements for ADS systems that would provide a more complete T&E capability in the future, is to:

1. Prioritize the concerns and constraints identified under Issue 2,

2. Add to these, constraints and concerns obtained from a survey of T&E experts,

3. Develop requirements for future ADS development that would alleviate these constraints and concerns, and

4. Prioritize these constraints and concerns using input from T&E experts.

5.3 ANALYSIS SUMMARY

The three JADS program issues will be addressed (or answered) by aggregating the results of measures into subobjectives, objectives, and issues as appropriate for each of the JTF tests. Because the JADS tests were chosen so as to "test" different weapon systems and different potential applications of ADS, there will be little, if any data, from the two tests that can be directly aggregated to improve statistical confidence, etc. Nonetheless, it is expected that the sum of the two tests will provide at least a minimum of data regarding ADS applicability to typical T&E weapon system classes.

Whenever possible, quantitative measures will be melded into quantitative objectives. Many of the objectives have measures that are primarily a qualitative assessment of the data collected which will be developed through the joint efforts of JADS personnel and subject matter experts. Opinion surveys will be employed and tallied for the more direct questions such as "degree to which participants were able to distinguish between virtual and constructive and real assets." Subtle objectives such as "assess ADS capability to support the early phases of the acquisition process" are not directly tested by JADS. The insights to such issues will come from a combination of results of similar tests, demonstrations, and projects such as Anti-Armor Advanced Technology Demonstration and Joint Advanced Strike Technology. Such results will be melded with opinion surveys given to experienced testers and requirements specialists in order to best answer the issues.

Each of the JTF ADS tests, the SIT and the ETE, will have detailed test planning information developed in follow-on Test Activity Plans (TAPs). Currently one TAP is planned for each phase of each of the two tests. It is expected that the TAPs will contain detailed analysis information (for each issue, objective, and measure). For each TAP, the data management plans will also be detailed, i.e.

- data requirements,
- data sources,
- data collection,
- data reduction,
- data quality control,
- data archiving and retrieval,
- data analysis, and
- data presentations.

As the detailed knowledge for tests continues to unfold, more detail will be developed concerning the intended analysis methods. The TAPs will contain matrices identifying test events for each test and their link to objectives, subobjectives, and measures.

Table 5-2. Analysis Issues, Objectives, Measures, and Description of Measures

Issues	Objectives	Measures	Description of Measures
Issue 1: What is the present utility of ADS, including DIS, for T&E?	Objective 1-1: Assess the validity of data from tests utilizing ADS, including DIS, during test execution.	M 1-1-0-1: Degree to which ADS provides valid SUT data.	This measure is a subjective measure of data validity. Data for this measure will be obtained via structured questionnaires from SUT data analysis personnel who have been doing analysis of SUT data collected under non-ADS test conditions. Their experience and expertise with SUT data will be invaluable for this measure. It is anticipated that the rating scale used will indicate a range from "a very high degree" down to "an unacceptably low degree."
		M 1-1-0-2: Percentage of ADS data which are valid (data supporting test measures which are timely, accurate, reliable, and otherwise faithfully represent real world systems data).	This measure provides a quantitative value for the data validity objective. The data elements used to generate the SUT measures of performance and effectiveness will be used as the basic data elements to be evaluated for validity. Validity criteria in terms of accuracy, timeliness, and reliability for each data element will be obtained wherever possible from the SUT analysts in concert with the JTF analysts prior to the start of the ADS tests. Following each JTF trial, each of the data elements will be reviewed by JTF analysts in concert with SUT analysts for compliance with the criteria (where possible). The percentage will be computed by summing the total time for each data element when the criteria was met, and dividing this by the sum of the total time for each data element. It is expected that subordinate measures will be developed to capture details of the effects that are observed, e.g. Number of ADS data elements that are valid, Number that are invalid, etc. What is desired is that the ADS system collect and distribute the requisite data to the requisite entities in a manner such that test performance is not impacted. The factors that cause this to be not true will be captured via the developed measures and the analysis discussion attached to this measure.
		M 1-1-0-3: Degree to which test participants were able to distinguish between ADS (virtual or constructive) and live assets.	This measure and the following measure are intended primarily for the ETE where human observers will view synthetic displays of activity, some of which will be live, and some not. It may also apply to the SIT and the HWIL sensor's ability to distinguish between the live and the virtual target in Phase 2. An ideal ADS test is one where participants (human or otherwise) could not identify live versus computer generated entities. However, this is not a requirement for test utility. The requirement is that, for those cases where participants could detect differences, the actions taken were not impacted by that knowledge.

Issues	Objectives	Measures	Description of Measures
Issue 1: What is the present utility of ADS, including DIS, for T&E? (continued)	Objective 1-1: Assess the validity of data from tests utilizing ADS, including DIS, during test execution. (continued)	M 1-1-0-4: Degree to which test actions were impacted due to the ability to distinguish between ADS and live assets.	This measure captures the necessary data regarding impact upon test activity from the previous measure. The combination of the two measures will provide a measure of validity for T&E.
	Objective 1-2: Assess the benefits of using ADS, including DIS, in T&E.		
	Subobjective 1-2-1: Assess ADS capability to support the early phases of the acquisition process.	M 1-2-1-1: Degree to which ADS can improve COEAs.	This measure is intended to capture the utility of ADS to the COEA process. The JTF will obtain data from other service tests that use ADS technology as appropriate to derive this measure as well as expert opinion from T&E and COEA experts. The specific data elements (questions) that will combine to provide this measure will have to be carefully worded so that the data are not biased in favor of or against ADS. Although a given individual response will be somewhat judgmental and based upon personal biases, it is expected that the aggregate can be given reasonable weight, since personnel asked to contribute will be experts. Structured questionnaires will be developed by the JTF to obtain the data elements needed for this measure. These questionnaires will be administered by JTF personnel only after sufficient testing has been accomplished to evaluate the data validity issue of ADS. It is expected that the values assigned to this measure will range from a "high degree of value added" to “no value added.” [Note: The discussion provided for this measure applies equally well to all subjective expert opinion measures which follow, unless otherwise noted.]
		M 1-2-1-2: Degree to which ADS can improve requirements development.	This measure is intended to capture the utility of ADS to requirements development. See M 1-2-1-1.
		M 1-2-1-3: Degree to which ADS can improve trade studies.	This measure is intended to capture the utility of ADS to trade studies. See M 1-2-1-1.
		M 1-2-1-4: Degree to which ADS can improve Early Operational Assessments.	This measure is intended to capture the utility of ADS to Early Operation Assessments. See M 1-2-1-1.

Issues	Objectives	Measures	Description of Measures
		M 1-2-1-5: Percentage decrease/increase in cost during early acquisition phase due to ADS.	This measure is intended to capture the utility of ADS to the early system acquisition phase. Data will be collected regarding the total non-recurring and recurring cost for each ADS test. To the degree possible, data will be compared to the total recurring and non-recurring cost of comparable non-ADS test.
Issue 1: What is the present utility of ADS, including DIS, for T&E? (continued)	Objective 1-2: Assess the benefits of using ADS, including DIS, in T&E. (continued)		
	Subobjective 1-2-2: Assess ADS capability to support T&E planning and test rehearsal.	M 1-2-2-1: Degree to which test concept/design is improved by ADS.	This measure is intended to capture the utility of ADS to development of test concepts and test designs. See M 1-2-1-1.
		M 1-2-2-2: Degree to which pre-test rehearsals of test exercise/ control procedures using ADS improved test preparations.	This measure is intended to capture the utility of ADS to test rehearsals and test/exercise preparations. See M 1-2-1-1.
		M 1-2-2-3: Degree to which pre-test rehearsals of data management procedures using ADS improved test preparations.	This measure is intended to capture the utility of ADS to pre-test rehearsals of data management procedures. See M 1-2-1-1.
		M 1-2-2-4: Degree to which pre-test exercise of data reduction and analysis routines using ADS improved test preparations.	This measure is intended to capture the utility of ADS to pre-test exercise of data reduction and analysis routines. See M 1-2-1-1.
		M 1-2-2-5: Degree to which ADS can be used for tactics development prior to test execution.	This measure is intended to capture the utility of ADS to tactics development prior to test execution. See M 1-2-1-1.
		M 1-2-2-6: Percentage decrease/increase in test planning and rehearsal cost due to ADS.	This measure is intended to capture the utility of ADS to test planning and rehearsal. Data will be collected regarding the total non-recurring and recurring cost for each ADS test. To the degree possible, these data will be compared to the total recurring and non-recurring cost of comparable non-ADS tests.

Issues	Objectives	Measures	Description of Measures
	Subobjective 1-2-3: Assess ADS capability to support T&E execution.	M 1-2-3-1: Degree to which ADS can add assets to test execution.	This measure is intended to capture one of the potential aspects regarding the utility of ADS to test execution. See M 1-2-1-1.
Issue 1: What is the present utility of ADS, including DIS, for T&E? (continued)	Objective 1-2: Assess the benefits of using ADS, including DIS, in T&E. (continued)		
	Subobjective 1-2-3: Assess ADS capability to support T&E execution. (continued)	M 1-2-3-2: Degree to which added ADS assets added value to the test (realism) beyond that available without the appropriate numbers or types of targets, threats, etc.	This measure is intended to capture one of the potential aspects regarding the utility of ADS to test execution. See M 1-2-1-1.
		M 1-2-3-3: Degree to which ADS can increase test time, events, etc.	This measure is intended to capture one of the potential aspects regarding the utility of ADS to test execution. See M 1-2-1-1.
		M 1-2-3-4: Degree to which ADS can test hazardous or unsafe conditions safely.	This measure is intended to capture one of the potential aspects regarding the utility of ADS to test execution. See M 1-2-1-1.
		M 1-2-3-5: Degree to which ADS can be used to validate DT&E specification compliance (sooner or at less cost), e.g. using HWIL simulations.	This measure is intended to capture one of the potential aspects regarding the utility of ADS to test execution. See M 1-2-1-1.
		M 1-2-3-6: Percentage decrease/increase in test execution cost due to ADS.	This measure is intended to capture one of the potential aspects regarding the utility of ADS to test execution. Data will be collected regarding the total non-recurring and recurring cost for each ADS test. To the degree possible, these data will be compared to the total recurring and non-recurring cost of comparable non-ADS test.
Issue 2: What are the critical constraints, concerns, and methodologies when using ADS for T&E?	Objective 2-1: Assess the critical constraints and concerns in ADS performance for T&E.		

Issues	Objectives	Measures	Description of Measures
	Subobjective 2-1-1: Assess player instrumentation and interface performance constraints and concerns.	M 2-1-1-1: Degree to which live, virtual, and constructive entities exist, can be instrumented, and can be readied for a test.	This measure will provide an assessment of the ADS support infrastructure. Test data will be collected regarding resource and time requirements to prepare live, virtual, constructive for the tests. These data will be analyzed to present a comparison of test preparation activities for ADS as compared to non-ADS tests. Data regarding availability of virtual and constructive entities will be also be obtained and used in the analysis. It is expected that as the JTF tests are executed, lessons learned data will be accumulated to satisfy this Subobjective. Additionally, surveys will be used to collect data.
	Subobjective 2-1-2: Assess network and communications performance constraints and concerns.	M 2-1-2-1: Degree to which network systems are available for ADS use.	Data will be collected regarding network system availability for the JTF testing. The data elements will capture data such as the number of times scheduled testing had to be rescheduled, the desired test schedule plan versus the actual test schedule plan (due to known network schedules), etc.
		M 2-1-2-2: Percentage of ADS trials canceled or otherwise not used due to network problems.	This measure will indicate the maturity of the ADS networks used in the JTF tests.
		M 2-1-2-3: Percentage of available bandwidth (average, peak) used by entity type.	Network performance monitoring systems will be used to obtain data regarding network loading and utilization.
		M 2-1-2-4: Percentage of available bandwidth (average, peak) used by PDU type.	Network performance monitoring systems will be used to obtain data regarding network loading and utilization by PDU type.
		M 2-1-2-5: Percentage of time PDUs were received out of order by a network node.	Network performance monitoring systems will be used to obtain these data. Specialized software tailored to distributed systems network performance will be used. For this measure and the following, all data whether in DIS or ADS format, is included in the term "PDU."
		M 2-1-2-6: Percentage of total PDUs required at a node that were delivered to that node.	Network performance monitoring systems will be used to obtain these data. Specialized software tailored to distributed systems network performance will be used.

Issues	Objectives	Measures	Description of Measures
Issue 2: What are the critical constraints, concerns, and methodologies when using ADS for T&E? (continued)	Objective 2-1: Assess the critical constraints and concerns in ADS performance for T&E. (continued)		
	Subobjective 2-1-2: Assess network and communications performance constraints and concerns. (continued)	M 2-1-2-7: Average and peak data latency between ADS nodes.	Network performance monitoring systems will be used to obtain these data. Specialized software tailored to distributed systems network performance will be used.
	Subobjective 2-1-3: Assess the impact of ADS reliability, availability and maintainability on T&E.	M 2-1-3-1: Percentage of trials delayed, rescheduled, and/or redone due to the ADS systems' (exclusive of network) unavailability.	This measure addresses the availability of ADS nodes. Data for this measure will be obtained from the test execution logs.
		M 2-1-3-2: Percentage of ADS trials delayed, rescheduled, and/or redone due to unavailability of planned networks (e.g. DSI).	This measure addresses the availability of ADS networks. Data for this measure will be obtained from the test execution logs.
		M 2-1-3-3: Percentage of trials in which network connection was lost long enough to require trial cancellation.	This measure addresses the reliability of ADS networks. Data for this measure will be obtained from the test execution logs.
		M 2-1-3-4: Degree to which trial delays, reschedules, redo's compare to real world delays, schedules, redo's due to weather, maintenance, etc.	This measure provides a comparison of reliability, availability, and maintainability between ADS and non-ADS tests. Data for this measure will be obtained from the test execution logs.
		M 2-1-3-5: Mean operating time between ADS system failures (severe enough to require trial cancellation).	This measure addresses the maturity of ADS systems and associated networks. Data for this measure will be obtained from the test execution logs.
		M 2-1-3-6: Average down time due to ADS network failures.	This measure addresses ADS systems maintainability. Data for this measure will be obtained from the test execution logs.

Issues	Objectives	Measures	Description of Measures
Issue 2: What are the critical constraints, concerns, and methodologies when using ADS for T&E? (continued)	Objective 2-2: Assess the critical constraints and concerns in ADS support systems for T&E.		
	Subobjective 2-2-1: Assess the critical constraints and concerns regarding ADS data management and analysis systems.	M 2-2-1-1: Degree to which ADS nodes provide for collection, data entry, and quality checking of pre and post trial briefing data.	Due to the distributed participants in an ADS test, pre and post test briefing data at the distributed locations will need to be collected, entered (into computer formats), quality checked, and submitted to the test analysis location. While no problems are anticipated, this measure provides a mechanism for capturing unforeseen problems and nuances. Data for this measure will be obtained during the tests.
		M 2-2-1-2: Adequacy of relevant test data storage at ADS nodes.	It is expected that for some tests, the volume of data will be such that each distributed node will retain the detailed SUT and instrumentation systems performance data, and only the relevant data distributed to the analysis center. Data for this measure will be obtained during the tests.
		M 2-2-1-3: Adequacy of data translation systems at ADS nodes.	This measure will address a particular aspect of distributed simulations, namely the need to bring data together for analysis. Data for this measure will be obtained from the JTF tests as data from the various nodes are "reformatted" for use at the JTF TCAC.
		M 2-2-1-4: Ease with which data can be retrieved, post-trial, from a given node.	This measure will address the need to assemble data post test for analysis. Data for this measure will be obtained during, or sometime following, the JTF tests.
	Subobjective 2-2-2: Assess the critical constraints and concerns regarding configuration management of ADS test assets.	M 2-2-2-1: Degree to which test managers can control the configurations of ADS participants, the ADS environment data, and ADS networks.	A significant aspect of distributed simulations, especially as these systems are in their infancy and are rapidly changing, is the changing configurations. This measure will address configuration management of ADS assets.

Issues	Objectives	Measures	Description of Measures
		M 2-2-2-2: Degree to which entity data exchange standards exist and are adequate.	Another significant aspect of distributed simulations, especially as these systems are in their infancy, are the new and changing protocol standards. Data regarding availability and suitability of entity data exchange standards will be collected with respect to the particular test entities involved in the two tests. Data for this measure will be obtained from the JTF tests.
Issue 2: What are the critical constraints, concerns, and methodologies when using ADS for T&E? (continued)	Objective 2-3: Develop and assess methodologies associated with ADS for T&E.		
	Subobjective 2-3-1: Develop and assess methodologies associated with test planning for tests using ADS.	No measures have been developed for this Subobjective.	Methodologies will be developed and documented for test planning for tests using ADS under this Subobjective. The effectiveness of these methodologies will be addressed in the first issue.
	Subobjective 2-3-2: Develop and assess methodologies associated with test execution and control for tests using ADS.	M 2-3-2-1: Degree to which specialized rules of engagement are required for live, virtual, and constructive entity mixes.	It is expected that, due to the distributed aspects of ADS, specialized test conduct rules may need to be established. This measure captures that need. Data for this measure will be obtained from the JTF tests.
		M 2-3-2-2: Ease with which rule/ constraint violations may be accomplished without detection.	For tests involving competing human participants, the urge to "cheat" is very strong. This measure addresses that aspect of operational testing. Data for this measure will be obtained from the JTF tests.
		M 2-3-2-3: Degree to which protocols, processes and procedures are needed to enable effective, centralized test control.	Due to the distributed nature of ADS, it is expected that test control may require specialized processes and procedures. This measure attempts to capture that need. Data for this measure will be obtained from the JTF tests.
		M 2-3-2-4: Degree to which real-time analysis systems support test safety and other test control requirements.	Due to the distributed nature of ADS, it is expected that test safety and other test control requirements may require specialized real-time analysis systems. This measure attempts to capture that need. Data for this measure will be obtained from the JTF tests.

Issues	Objectives	Measures	Description of Measures
	Subobjective 2-3-3: Develop and assess methodologies associated with data management and analysis for tests using ADS.	No measures have been developed for this Subobjective.	Methodologies will be developed and documented for test data management and analysis for tests using ADS under this Subobjective. The effectiveness of these methodologies will be addressed in the first issue.
Issue 2: What are the critical constraints, concerns, and methodologies when using ADS for T&E? (continued)	Objective 2-3: Develop and assess methodologies associated with ADS for T&E. (continued)		
	Subobjective 2-3-4: Develop and assess methodologies associated with verification, validation, and accreditation (VV&A) for tests using ADS.	No measures have been developed for this Subobjective.	Methodologies will be developed and documented for verification, validation, and accreditation (VV&A) for tests using ADS under this Subobjective. The effectiveness of these methodologies will be addressed in the first issue.
Issue 3: What are the requirements that must be introduced into ADS systems if they are to support a more complete T&E capability in the future?	Objective 3-1: Identify requirements for ADS systems that would provide a more complete T&E capability in the future.	No measures have been developed for this Objective.	The JADS tests, and data from other service tests that use ADS technology, will provide data that can be used to satisfy the objective. The ranking of the requirements will be a function of opinions of senior T&E managers.

6. DATA MANAGEMENT

6.1 GENERAL

The JADS JT&E methodology and specific test activities generate the data management and analysis support requirements. This section outlines the documentation of what is needed to define the data and instrumentation requirements and ensure that the data are properly collected, handled, controlled, stored, and provided to JTF personnel to support program objectives.

The goal of JADS data management is to provide the requisite data to support the JT&E analysis efforts while using existing data collection and reduction capabilities to the maximum extent possible. The data generated during the numerous test activities represent a major investment of time, funds, and personnel. Because the data will come from several sources and different data collection systems, there will be a requirement for completeness and consistency in data management. The JADS JT&E data management function will be structured to provide effective and efficient data collection, control, and processing.

Although emphasis will be placed on using existing data collection and reduction capabilities to the maximum extent possible, the JTF will require absolute assurance that data integrity is maintained from the data collection point through the analysis process. The JT&E data management function is structured to ensure that these data will be carefully controlled and made available for analysis when and where they are needed. Data reduction and analysis support functions will be conducted at the various sites by host test organizations. Activities at the test sites will focus on data collection, initial quality control, integrity checks, and data transfers.

This section provides an overview of the data management process with discussions on data sources, data flow, data management activities, data handling and storage, data reduction and certification, and analyst support. Detailed descriptions of these processes will be described in the individual test activity's data management and analysis plan (DMAP). Because of the complexity of managing data acquired in field tests, the following subsections focus on preparing for managing and processing the data acquired from these tests.

6.2 DATA REQUIREMENTS

Each test activity has been designed to provide data to address the various system under test measures as well as the ADS measures. The primary source of data requirements evolve from the defined test measures that must be satisfied. However, as shown in Section 5, there are also other sources of data requirements (i.e., test variables, test participants, test activity environment, and system operations and interactions). It is extremely important that test activity planning be conducted in a manner to ensure that the data required for analysis are collected and that the data collected can be associated with all the factors that influenced each test trial. The JTF will use an

Integrated Data Requirements List (IDRL) as the tool to bridge the gap between the data requirements needed to address JADS test issues and how those data elements will be collected.

The IDRL is a comprehensive list that contains the name of the data element, a description, the data source, the responsible party, frequency of collection, data format, instrumentation required, data medium, data source status, data classification, affected measures, and other pertinent information as required. Table 6-1 represents a sample IDRL and illustrates the format that will be used for data collection. The IDRL will not only be used at the program level to define the data elements, but an IDRL will also be developed for each individual test activity. The IDRL provides the justification for collecting each data element by documenting the measures or requirements that each data element supports.

Table 0-1. Example of Integrated Data Requirements List Format

Data Number Data Category	Data Element	Source	Responsible Party	Instrumentation	Classification	Affected Measures
MEASURES						

6.3 INSTRUMENTATION & DATA COLLECTION SOURCES

The JADS JTF does not own all of the instrumentation necessary to make the measurements planned for the test activity. The JTF will rely heavily on existing range instrumentation to collect data for systems under test (i.e. AMRAAM and Joint STARS). However, the JADS JTF will have equipment and software to collect network performance data such as DIS PDUs for playback and network latency and dropout rates. Additionally, the JTF will be relying on portable computers and paper instruments for conducting interviews/questionnaires and collecting expert opinions.

6.4 DATA FLOW

The JTF's data management approach traces the movement and processing of data from the collection points to creation of the final analysis products. This flow is shown in Figure 6-1, which is representative with many steps summarized for brevity. Data will be generated at numerous locations to include Eglin AFB, NAS Point Mugu, NAS China Lake, White Sands Missile Range, Fort Huachuca, Melborne, Fort Sill, Fort Irwin, and Kirtland AFB.

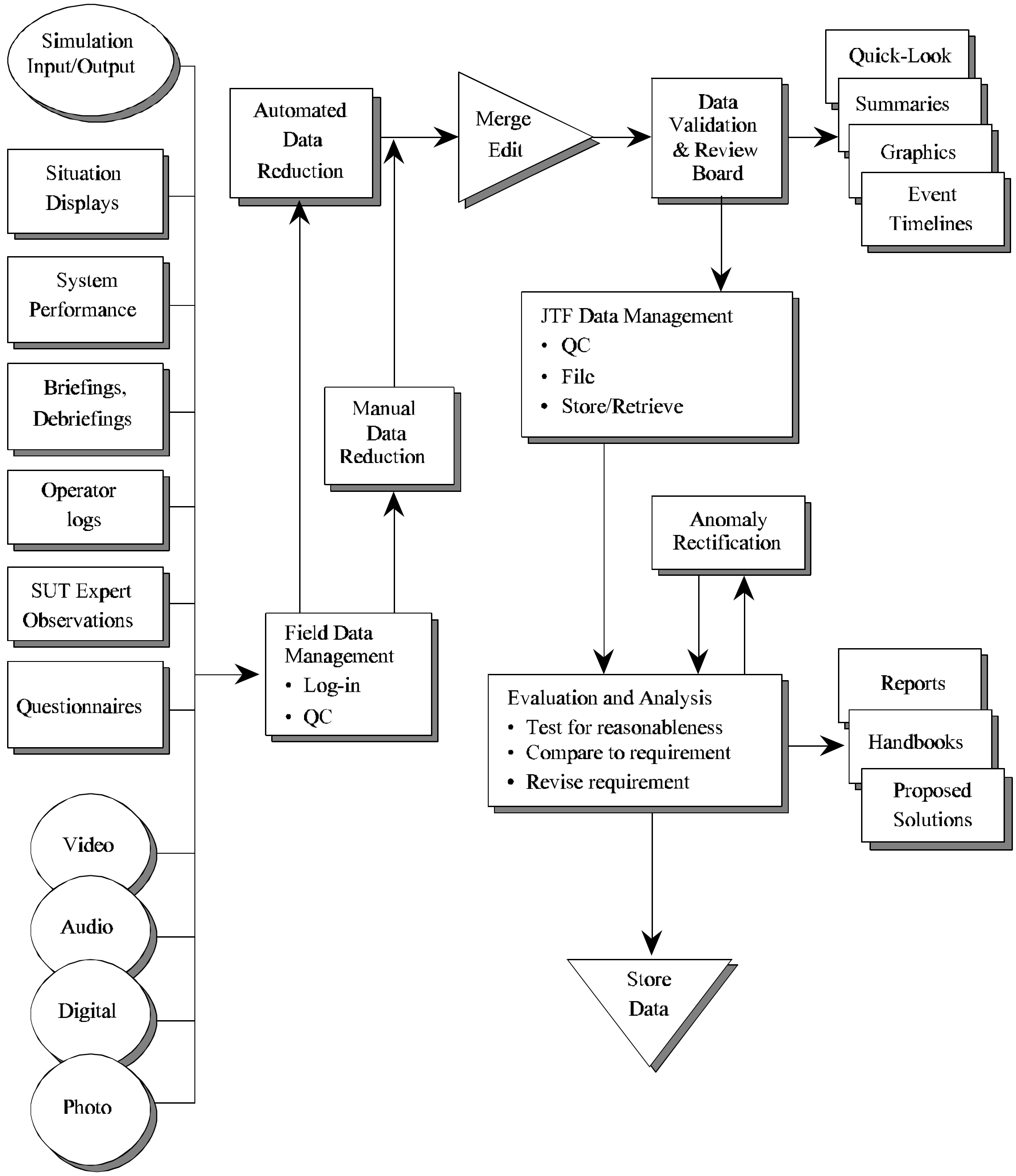

Figure 6-1. JADS Data Flow

The data management and tracking process starts at the test activity location and involves keeping track of the data as they are generated and used in the quality assurance review.

The quality assurance process is conducted to confirm data quality, expected data quantities, and the performance of the collection systems.

The JTF will obtain data from the instrumentation systems available at the test activity locations. Thus, the applicable portions of these systems will be specified in the individual test activity plans. This data flow documentation will trace the data from the point of origin to the host organizations collection and reduction facility. The process will determine the JTF and host interface points and define the transfer media and data formats for test activity data. The JTF will establish a quality assurance process at each site to perform quality and quantity checks on the data being collected. Procedures will be established in the individual test activity plans to provide for timely and appropriate flow of data from the host organization to the field data manager through the quality assurance process. Once the data media processing and quality review are completed on location, the data will be transferred to the JTF data library.

6.5 DATA HANDLING & CONTROL

The JTF data manager at JADS Headquarters will direct and monitor all test location data management efforts. Central control is required to ensure that all data are collected in a consistent manner at each of the test activities so that they can be entered in the JADS database. Because data will be generated at several locations, a single data manager will not be able to provide continuous on-site supervision. Therefore, a designated individual at each test location will be responsible to the JADS data manager for insuring proper data management.

Data management control procedures will emphasize reviews at critical points in the data flow to permit feedback on how well data management is being performed. To facilitate these reviews, the JTF will implement a positive control system. This system permits the JTF to determine the data required for each test site, prior to the actual conduct of the test. The system also assigns unique control numbers to each piece of data media and prepackages the data for analysis at JADS Headquarters. In this way the JTF will be assured that each collection site receives the correct data media, that all the data media for a trial has been returned to the control system, and that the data resident on the media has been entered into the data reduction process.

It will be necessary to establish training programs to ensure that all personnel implementing the data management system have the capability to perform their assigned tasks. The individual JADS activity plans contain detailed procedures for training and verifying that the data management system operates effectively.

6.6 EVENT RECONSTRUCTION & VALIDATION

To prepare for final data validation, the JTF will conduct thorough trial and event reconstruction to verify the quantity and quality of the test activity data. A reconstruction/validation methodology will be developed based on the testing approach, the required data elements, and the operating parameters of the test participant systems. Prior to planned test activities, the JTF will ensure the required trial/event features are captured to obtain sufficient data to support the intended analyses. During the test activity, the JTF will measure the collection effort against these documented trial/event features to determine whether there are data deficiencies. During post-test, the methodology will be used to associate test activity data with test condition data to ensure that they were collected under the correct conditions and are suitable for use in the planned analyses. The reconstruction team will prepare reports describing the quality and suitability of the test data for inclusion in the JADS analysis data base. Once completed, the reports will be submitted to a validation committee for approval.

The JADS JTF will establish a Data Validation Committee to review and approve all data prior to entry of the data into the JADS analysis data base. The committee will review inputs from the reconstruction team and various summaries of the test activity data. Explanations and accounts of what happened will be reviewed and all questions or concerns will be resolved before the committee validates the data.. Disposition of data that cannot be validated will be determined by the committee. Only test activity data approved by the Data Validation Committee will be entered in the JADS analysis database.

6.7 DATA REDUCTION

Data reduction begins at the test activity locations and continues until the data have been stored in the JADS final data base. During the planned test activities, there is the potential for collection of more data than the JTF requires to address the JT&E objectives. The JTF will scope the data requirements for each test activity location and provide specific guidance on the type and amount of data required to the organizations collecting data to meet those requirements. In some cases, this may require the test location organization to extract the specified data from their collection systems and provide them to the JTF in a particular media and format to meet JTF needs. This extraction and presentation of the data in JTF-desired formats will be the first step in the process to reduce and organize the data to meet the JTF analytical requirements.

The JTF will use host organization data collection and processing capabilities to the maximum extent possible. The JTF will be responsible for the collection and reduction of JT&E peculiar data (i.e. latencies, etc.). Additionally, the JTF will be responsible for collecting information from systems that are participating in the test activity and have unique instrumentation requirements not provided by the host organization’s data collection network (i.e., TCAC).

JADS data management personnel at the test site may perform data consolidation tasks during performance of data collection and quality assurance activities.

6.8 DATA STORAGE AND RETRIEVAL

JADS will store all data generated during the course of a test, including raw and reduced data and the final test results. The data will be used to show that one could collect, store, and retrieve sufficient data to control and analyze a test from a distributed location. Sybase will be used to store data generated during the conduct of the test (network and system under test data) and MS Access will be used to manage the interview/questionnaire/expert opinion data collected.

6.8.1 Data Library

The JADS Data Library will be able to receive and handle data in a variety of media forms: floppy disks, optical disks, magnetic tape (analog and digital), hardcopy, and video/photographic records. Both automated and manual quality control processes will be in place at the receipt of all data into the library to ensure data standardization, format, and technical quality. A system will be developed for labeling all JADS data and providing an efficient inventory and control system.

6.9 QUALITY CONTROL/ASSURANCE

The JADS JTD will appoint a data quality assurance team that will review all data collection procedures in order to assure data is collected, stored and retrieved in such a fashion as to not alter the contents of data collected for individual tests. Much of the data quality assurance will overlap with the test VV&A function.

7. LEGACY PRODUCTS

7.1 PURPOSE

A key concern of OSD and the TAB members was how the insights gained by the JADS JTF will be transitioned to the T&E community. A transition plan will be developed to identify the T&E organizations (e.g., OSD, program managers, developmental testers, operational testers, test ranges, test facilities, etc.) that could benefit from the JADS JTF legacy and the approach to be taken for each. The plan will take into account the needs of each individual organization and the time frame that the information is available. The products supplied will serve two purposes: first, to inform the T&E community on the benefits and potential pitfalls of using ADS in T&E, and second, to educate these T&E organizations on how to incorporate ADS in T&E planning. Additionally, the JADS JTF will facilitate the use of ADS in T&E through recommending changes to policy and infrastructure and identifying centers of excellence and through developing a training program to aid the user in determining how to design, develop, VV&A, execute, and analyze an ADS supported test. The transitioning process has already begun and will continue, also, through JADS briefings at symposiums, workshops, and conferences sponsored by the T&E community and through maintaining close working relationships with T&E organizations. Since the majority of insight will be gained during the conduct and analysis of the JADS test activities, most of the legacy products will be transitioned after testing has started. These products will enable the transition of knowledge to continue after the limited life of the JT&E has expired.

This section describes the contents of the legacy products along with the media of the product (e.g., paper hardcopy, diskette, video, or CD-ROM), and the primary strategy for distributing the JADS JTF insights to the T&E community. Specific products and means of distribution for each T&E organization will be identified in the transition plan. There are two broad categories of legacy products: documentation and ADS tools. The documentation developed will portray the history of the JADS JT&E activities and the lessons learned in order to provide illustrative examples for future ADS applications. ADS test tools will contain the ADS test methodologies (i.e., procedures for designing, developing, VV&Aing, executing, and analyzing an ADS test) along with appropriate hardware and software for testers to use in applying the ADS technology to future test programs.

7.2 DOCUMENTATION

7.2.1 Briefings

Briefings will be presented to T&E organizations and to professional organizations at workshops, symposiums, and conferences on the JADS purpose, test activities, lessons learned, and methodologies. These briefings will be delivered in hard copy and/or via electronic mail, Internet, or diskette to all interested parties.

7.2.2 Interim reports

Interim reports will record significant insights learned along the course of the JT&E. An interim report will be prepared at the completion of each phase of each JADS test. If needed, separate interim reports will be published to record significant JADS findings from other ADS tests. These reports will be delivered in hard copy and/or via electronic mail, Internet, or diskette to all interested T&E organizations.

7.2.3 Final report

The JADS final report will serve as a permanent record of the results of the JT&E by documenting each test program's design, progression, execution, and analysis along with any related information relevant to the assessment of the test results. The report will fully describe each test program, the rationale associated with the methods used, the strengths and weaknesses, cost benefits, value added, and lessons learned. The report will also contain a full description of other ADS test activities monitored and analyzed by the JADS JTF. With each test activity in the report, an assessment of the ability of ADS to support future testing of the same class of systems (e.g., missile, C^4I, EW) will be included. Sample accreditation plans and reports for each test will be included as an annex to the final report. Recommendations for improving ADS components and test methodologies will also be documented in the final report with intent to enhance the future utility and credibility of ADS supported tests. The report will be summarized in an annotated briefing capturing the key findings and recommendations of the JADS JT&E. Both the briefing and report will be modular in nature to allow testers to view only the portions of interest to them. The final report and briefing will be delivered in hard copy and/or via electronic mail, Internet, or diskette to all interested T&E organizations.

7.2.4 JADS Libraries

Two libraries will be produced by the JADS JT&E, a reference library and a data library. The reference library will contain all ADS-related reference material collected during the life of the JT&E. The data library will consist of all data generated or collected during the course of the JT&E (see Section 6.8.1). The JADS libraries will be bequeathed to one of the ADS T&E Centers of Excellence at the end of the JT&E. The reference library will be delivered in paper hard copy. The data library will be delivered on appropriate media (see Section 6.8.1).

7.2.5 Road Map

A road map will be prepared to guide T&E organizations to continue involvement in the ADS community. This road map will be based on issues with the technology, lessons learned from the JT&E experience, and other needs identified by the test team and T&E organizations. The road map will be developed as JADS JT&E progresses, noting the lessons learned along the way, and should help to ensure that future ADS technology developments will address the needs of T&E users. Additionally, during the progression of the JADS JT&E, the JADS JTF will develop recommendations for improvement to ADS technology needed to support T&E in the future. These recommendations will be made to the appropriate organizations, such as DMSO and ARPA, working groups such as the various DIS user groups, and to developers of strategic plans for the services. The JADS JTF will also encourage T&E organizations to get involved in DIS and ADS-related activities.

7.2.6 Database of ADS Capabilities

Once an ADS user has preliminarily determined what players are needed and which should be live, virtual, or constructive, the user will need to determine what capabilities exist to represent each player, the status of the V&V performed on the capability, and who to contact about using them. The JADS JTF will develop the information requirements associated with this task, and will investigate existing test resource, range asset, and simulation databases to determine their appropriateness in meeting the needs of an ADS test designer. The plan is to select a single existing database or set of databases to meet these needs and to recommend changes as needed to include ADS capabilities. All ADS capabilities investigated in the course of the JADS JT&E are planned to be entered in that database. Cooperation of the database owner/maintainer will be necessary to accomplish this task.

7.3 ADS TOOLS

ADS test tools developed during the JADS JT&E will be documented and made available for use in other tests. These tools will aid testers in designing, building, VV&Aing, executing, and analyzing future ADS supported tests. The tools will consist of ADS test methodologies, the Test Control and Analysis Center, and an ADS training module.

7.3.1 ADS Test Methodologies

A set of methodologies will be developed to guide testers in designing each step of an ADS supported test. Each methodology will describe detailed procedures for that step. They will be described in an annex to the JADS final report, included in the ADS training module, and distributed over the Internet or other means. A description of each methodology is included below.

7.3.1.1 Design Methodology

Design procedures will be developed to guide testers in selecting the appropriate mix of live, virtual, and constructive players to link together to support specific objectives. Additionally, design procedures will include instructions for defining the network required to support the test design, for addressing the information to be exchanged between players, and for determining the appropriate data to be collected.

7.3.1.2 Build Methodology

The JADS team will develop build procedures to describe how to assemble the network, how to connect to the network, how to interface to the different live, virtual, and constructive players, and how to incorporate security devices and accredit the network (from a security standpoint).

7.3.1.3 VV&A Methodology

Verification and validation procedures will be developed to help testers verify that the ADS network they built correctly implemented the design and to help them validate that the outputs from the test are sufficiently representative of the real world. Accreditation procedures will be tailored to each T&E organization, following their policy, and will show the user how to develop and implement an accreditation plan and write the report. Sample accreditation plans and reports for each JADS test will also be available.

7.3.1.4 Execute Methodology

Procedures to control the test and collect data will be included in the execute methodology.

7.3.1.5 Analyze Methodology

The JADS legacy team will develop procedures for analyzing the data resulting from the ADS supported test. Both real-time and post-mission data collection, processing, display, and analysis will be covered.

7.3.2 Test Control and Analysis Center (TCAC)

Legacy products from the TCAC will include a guide to the hardware and software needed to perform the TCAC functions, along with procedures on how to conduct a distributed test (discussed above in the Build Methodology).

7.3.3 Multimedia Information Package

A multimedia module is planned for development, which will contain an informational tutorial for developing, executing, and analyzing an ADS supported test. The methodologies described above will be included in the module in an interactive, multimedia format conducive to learning. This source should be able to serve as a "cookbook" by which potential ADS users can educate themselves on ADS concepts and technology, learn which ADS applications are germane to their program, and learn how to design, build, VV&A, execute, and analyze an ADS supported test, and find the experts to contact for detailed assistance. Lessons learned will be highlighted in the module to facilitate application of the insights gained during the JT&E. The module is planned to be delivered in CD-ROM format with paper hardcopy user's manual. A syllabus for an ADS training course will also be developed, with intent to establish a training program or training center(s) to teach the course after the completion of JADS tests.

Additionally, during the implementation of the JADS JT&E, JADS team members will work with T&E organizations to assist them in determining how to apply ADS technologies to their program tests.

8. JTF MANAGEMENT

8.1 MANAGEMENT OVERVIEW

The JADS JTF was established with the Air Force as the lead Service, and with the Army and Navy as participating Services. The Air Force provides facilities, administrative, logistics, comptroller, and contracts support for the JTF, located at Kirtland AFB, NM. Each of the three Services are providing manpower support to ensure that the JTF is adequately staffed and properly executed. As lead Service, the Air Force nominated the Joint Test Director (JTD) who was approved by the Office of the Secretary of Defense, Deputy Director for Test, Systems Engineering and Evaluation, Test and Evaluation (DDTSE&E/T&E). Deputy Test Directors (DTDs) are provided by each of the participating Services to manage JT&E functions and represent their branches of the Armed Services. The Services are providing a total of 37 personnel to staff the JTF. Table 8-1 lists the source of these full time military and civilian personnel. A baseline of thirteen contractor personnel are also assigned to support the JTF. The number of contractor personnel will vary throughout the JT&E life cycle.

The JADS Force Activity Designator (FAD) is FAD II and the Air Force Precedence Rating is 2-6.

Table 0-1 Personnel Resources

	Air Force	Army	Navy
Military	19	12	2
Civilian	4	0	0

8.2 ORGANIZATION

The JTF has developed an organizational structure combining both functional responsibilities and matrix characteristics: test teams for each of the test programs, and centralized teams for network engineering, analysis, and support functions. Figure 8-1 is an overview of this organizational structure. Each test team is a cell of personnel focusing on the planning and execution of each phase of their test. The matrixed organizational teams consist of specialized personnel responsible for specific areas-network engineering, interface and model software development, data collection and analysis, legacy products, test team support functions, program planning, scheduling, resources, etc. Each team is designed as an integrated product team, comprised of members of each Service plus contractors, working in a seamless environment.

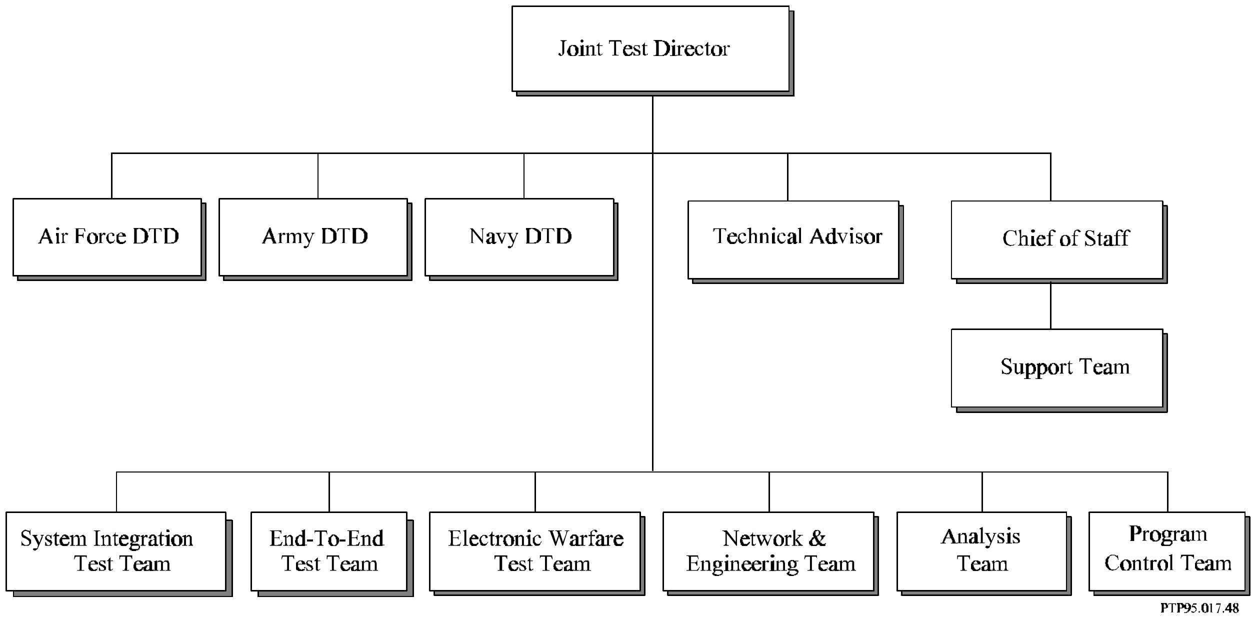

Figure 8-1. The JADS JTF Organization

8.2.1 Key Staff and Responsibilities

8.2.1.1 Joint Test Director (JTD)

The ultimate responsibility of the JTD is the successful execution and completion of the JT&E and achievement of the JADS JT&E objectives on schedule and within budget. The JTD will ensure that all aspects of each test activity are coordinated with Service components and that the results of these test activities are reported to OSD, the Services, the Joint Staff, and other agencies as may be appropriate. The JTD is responsible for the safe execution of test events without adverse environmental impact. The JTD is also responsible for the development and implementation of a comprehensive OPSEC plan to protect classified aspects of the program.

8.2.1.2 Technical Advisor

The Technical Advisor is responsible to the JTD for ensuring the JT&E approach remains technically sound, and in line with the top issues the JT&E was chartered to address. To accomplish this, the Technical Advisor works with each of the JADS teams, providing needed technical direction, to ensure the parallel test programs remain on track.

8.2.1.3 Air Force Deputy Test Director (Air Force DTD)

The Air Force DTD is the senior Air Force representative to advise the JTD on U.S. Air Force tactics, doctrine, techniques, resources, and technical and support capabilities. The Air Force DTD is also responsible to his/her Service for coordinating JT&E programs, activities and products.

8.2.1.4 Army Deputy Test Director (Army DTD)

The Army DTD is the senior Army representative to advise the JTD on U.S. Army tactics, doctrine, techniques, resources, and technical and support capabilities. The Army DTD is also responsible to his/her Service for coordinating JT&E programs, activities and products.

8.2.1.5 Navy Deputy Test Director (Navy DTD)

The Navy DTD is the senior Navy representative to advise the JTD on U.S. Navy tactics, doctrine, techniques, resources, and technical and support capabilities. The Navy DTD is also responsible to his/her Service for coordinating JT&E programs, activities and products.

8.2.1.6 Chief of Staff

The JADS Chief of Staff is responsible for many of the day-to-day functions of the JTF. Support responsibilities such as personnel, supply, administration and security fall under his/her jurisdiction.

8.2.2 Test Teams

The teams for each of the JADS test activities are responsible for the detailed planning and execution of each phase of their specific test program. These teams are SIT, ETE, and EW.

8.2.3 Network and Engineering Team

This integrated team is responsible for designing, developing and implementing the networks and associated interfaces necessary for executing each distributed test activity. The Network and Engineering Team is also responsible for maintaining and operating the Test Control and Analysis Center (TCAC).

8.2.4 Analysis Team

This integrated team is responsible for such actions as data collection, data reduction, analysis, program data management, pre-test simulation, and verification and validation.

8.2.5 Program Control Team

The Program Control Team provides a JADS-level aggregation of resources needed for executing the JT&E. Responsibilities include a program-level schedule that combines the timelines of each of the test activities, resource management to include inputs into the Service resources processes, and JADS legacy products.

8.2.6 Support Contractor Organization and Responsibilities

Contractor personnel are integrated into teams with government personnel, as outlined above. Lines of responsibility for contractor personnel run through the Principal Investigator, who is responsible for orchestration and accomplishment of contractor support of the JTD in meeting JT&E objectives and obligations on schedule and within budget.

8.2.7 Steering Committee

The JADS Steering Committee facilitates the crossflow of information, enhances coordination of efforts that cut across more than one team within the organization, and serves as a sounding board for fleshing out options on issues before addressing them to the JTD. Membership includes the three Service Deputies, the Technical Advisor and contractor principal investigator.

8.3 PROGRAM PERFORMANCE EVALUATION

8.3.1 Internal Program Reviews

The JTD will use a number of management tools to ensure that JT&E objectives are achieved on schedule and budget. These management tools will include work breakdown structures (WBS), task assignments, schedules, milestones, budget forecasts, resource commitments, technical performance measurements, and contractor performance reports. These tools will be monitored to appraise JTF and test activity status to identify potential conflicts and problems at the earliest opportunity. The JTD will conduct periodic Internal Program Reviews to stimulate new ideas to improve the program and assure that the JT&E is progressing on schedule and budget. Additionally, the JADS Steering Committee serves as a coordinating body to advise and assist the JADS JTD and JADS team leads in implementing their responsibilities under the JADS JT&E Charter.

8.3.2 External Program Review

Two types of External Program Reviews will be conducted: technical and program.

Technical reviews will be used to validate JTF concepts and approaches and to confirm that selected methodologies are valid and applicable. The JTD will establish a JADS Flag Officer

Steering Committee (FOSC) to advise on Service participation and resource commitment. Membership will include representatives from each Service's OT, DT and M&S communities. The JTD will also establish a JADS Technical Advisory Group (TAG) to advise on the technical aspects of planned test activities and legacy products. Members will be recognized technical experts from throughout the T&E and M&S communities.

Program reviews are status reports on the JT&E that include progress, milestone completions and projections, fiscal and budget status, problems, recommended or implemented solutions, and requests for assistance. These reviews will be provided as required to DDTSE&E/T&E and periodically to the Service agencies responsible for Joint Tests.

8.4 CONFIGURATION MANAGEMENT

Configuration management will primarily involve the development and update of instrumentation, software, and databases that the JTF will use to collect, control, and analyze data and provide reports to the JTD, staff, and external agencies. Configuration management procedures will follow the guidelines established in such standards as DOD-STD-2167A, 2168, and 480A.

8.4.1 Documentation

The JTF will establish quality standards in terms of completeness, legibility, compatibility, and reasonableness for all documentation. The JTD will review and approve all documentation prior to distribution of the document to an agency outside of the JTF or entry into the JTF database library. Strict configuration control of all documents produced by the JTF will be maintained. The following process will be used whenever an established document is distributed to the JTF staff for review/comment. Comments/recommendations will be submitted to the technical editor using a Test Document Configuration Control Sheet, as shown in Figure 8-2. The technical editor will consolidate these inputs into a single copy, and submit this copy with accompanying configuration control sheets, to the JTD or his designated representative. All changes will be approved by the JTD before incorporating into the document. The configuration control sheets will be maintained as a historical record of the evolution of the document.

<table>
<tr><td colspan="2">Document:</td><td colspan="2">Document Date:</td><td>Date:</td></tr>
<tr><td colspan="3">Reviewer:</td><td colspan="2">Page/Para/Line/Figure:</td></tr>
<tr><td colspan="5">Recommended Change:</td></tr>
<tr><td colspan="5">Rationale:</td></tr>
<tr><td colspan="5">JTD Incorporation Decision: ___No ___Yes
___Alternate Change:</td></tr>
</table>

Figure 8-2. Test Document Configuration Control Sheet

8.4.2 Identification and Categorization of Controlled Items

The following informal plans will be developed as internal management tools to identify and categorize controlled items:

8.4.2.1 Software Management Plan

This plan will serve as a guide for the management or refinement of software to satisfy JADS requirements. The plan describes the management procedures, documentation, coding standards and conventions, and testing requirements for JADS developed or refined software.

8.4.2.2 Hardware Management Plan

This plan will serve as a guide for the management of specialized equipment or instrumentation required to support JADS tests or activities. This document describes the procedures, documentation, and standards for the manufacture of modification of required equipment or instrumentation.

8.4.3 Configuration Change Request Evaluation

A problem report or enhancement recommendation will be considered as a change to an existing baseline that either will become a new baseline or will be rejected. Software, hardware and database changes will require a change in associated documentation at the same time. Change requests will be subjected to an engineering review and the preparation of a change proposal will be evaluated by a JADS Configuration Control Board (CCB). The CCB will approve or disapprove the configuration change request and, if approved, direct the change be incorporated into the new baseline. Figure 8-3 is an overview of the JADS configuration management process.

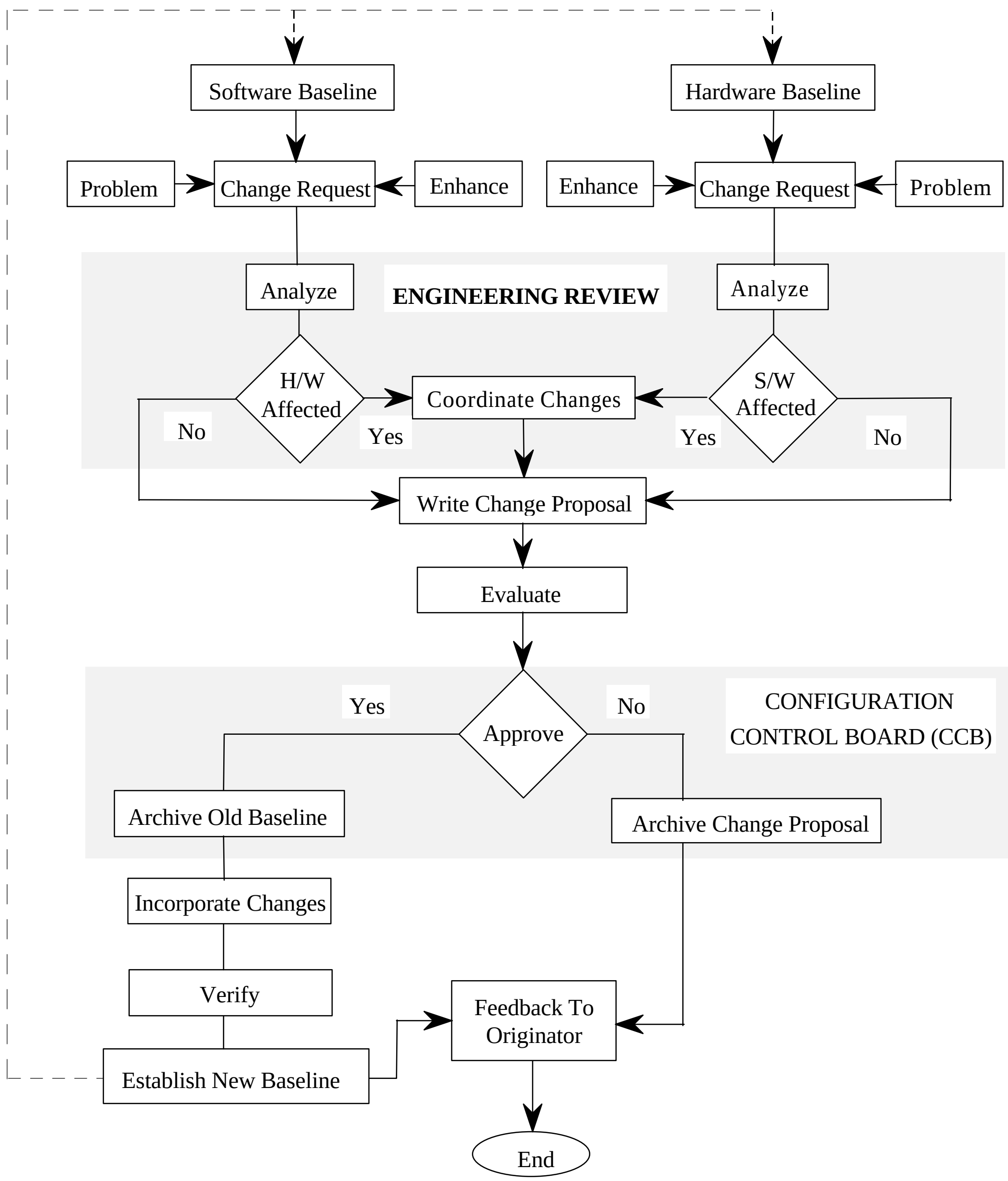

Figure 8-3. Configuration Management Process

8.4.4 Change Status Monitoring

The JADS Technical Advisor will chair the CCB and is responsible for the documentation and implementation of all CCB decisions. The Technical Advisor will establish a CCB decision monitoring system and will monitor decision actions until completion.

8.5 SECURITY

Some aspects of the systems being used in JADS tests, the equipment and techniques employed, and the data being collected may be sensitive or classified and require special protection, handling, and storage. Access may require special clearances or certification of need to know. The JADS Security Manager will be responsible for the classification and security of all data collected or generated and will establish personnel security clearance requirements for each test activity.

The JADS Security Manager will have the authority to request that each Test Site manager provide adequate information concerning the test sites, instrumentation, systems under test and associated system characteristics, JADS equipment and techniques being employed, the data being collected, and other aspects of the testing and proposed test operations to make security level determinations and decisions concerning classification and access. The JADS Security Manager will assign classification for data and will establish security procedures for access and handling of the data at the individual test sites and at the database processing locations. The JADS Security Manager will ensure that JTF personnel assigned to a test activity have the required security clearances to perform their duties.

The JADS Security Manager will coordinate with Test Site managers for determining appropriate classification levels for all aspects of the project and coordinating with local security officials to ensure compliance with security regulations. Test Site managers will be expected to take appropriate actions and report to the JADS Security Manager any actual or potential security problems affecting JADS test activities. All JTF members will ensure their actions are compatible with security requirements at all times and will be familiar with applicable security classification guides for the systems participating in the test.

Test Site managers are expected to coordinate with onsite security and intelligence personnel to identify foreign intelligence platforms which may be positioned to benefit from the execution of JADS tests. If required, test schedules or configurations will be adjusted, as practical, to prevent foreign intelligence collection.

All JADS documents and briefings will be classified according to guidelines set forth in the appropriate Security Classification Guides. This will include discussion of any classified technology as well as any classified performance measures. All JTF personnel will strictly adhere to security requirements for the individual test activities.

8.6 SAFETY

Safety will take precedence over all other concerns. Flight and ground vehicle safety is the responsibility of the command exercising operational control over the platform. All equipment will be safely operated in accordance with the applicable operator’s manual. When deployed, the Test Officer will be responsible for the overall safe conduct of the JADS event. He/she will ensure that all specific test facility safety requirements have been properly coordinated, incorporated into the test plan, and fulfilled during event conduct. The designated facility and unit's safety representative will review and approve the plan prior to any JADS active testing. Certification of these safety reviews will be part of the JADS Test Activity Plans. Any safety questions regarding the conduct of a test event will be directed to the JTD prior to the conduct of the test event.

8.7 ENVIRONMENTAL

During the conduct of each JADS test of data gathering activity, the environment will be protected from contamination or damage to local flora, fauna, landmarks, and populace. Planning of test events will be coordinated with applicable federal, state, municipal, or private agencies to ensure compliance with local environmental sensitivities and restrictions. To accomplish this, the Test Officer, in conjunction with the JADS Environmental Officer, will initially meet with representatives of the local test/range facility to identify environmental restrictions and potential issues. Test activities will be configured within categorical exclusions to the maximum extent possible. An Environmental Assessment, if required, will be prepared and submitted to the base Environmental Office. Authorization will be obtained in accordance with applicable directives and will be documented in the JADS Test Activity Plans.

8.8 FORMAL AGREEMENTS

Throughout the JT&E, the JTD will enter formal agreements with the DOD agencies supporting the tests. The agreements will be in the form of Interservice Support Agreements (ISSAs), Memoranda of Understanding (MOUs), and Memoranda of Agreement (MOAs). Several have been formalized, many are in coordination, and others will be worked with the appropriate lead time for the support required.

APPENDICES

Charter

A copy of the JADS Charter is included on the following pages as a reference. The document was scanned and electronically reproduced for use in this appendix.

OFFICE OF THE UNDER SECRETARY OF DEFENSE
300 DEFENSE PENTAGON
WASHINGTON DC 20301-3000

MEMORANDUM FOR VICE CHIEF OF STAFF, ARMY
ASSISTANT SECRETARY OF THE NAVY (RDA)
DIRECTOR, AIR FORCE TEST & EVALUATION

SUBJECT: Charter for the Joint Advanced Distributed Simulation (JADS) Joint Test and Evaluation (JT&E) Program

The purpose of this memorandum is to establish the charter for the Joint Advanced Distributed Simulation (JADS) Joint Test and Evaluation (JT&E) Program. The United States Army, Navy, and Air Force are designated as participating Services with the Air Force designated as the lead service for this JT&E. The Joint Test Director (JTD) reports to the Deputy Director for Air & Space Systems (DDT&E (A&SP)), Office of the Director, Test and Evaluation (ODT&E), Office of the Under Secretary of Defense (Acquisition and Technology), for execution of the JADS JT&E program; approval of JADS financial requirements, the program test design (PTD), and program test plan (PTP); and analysis and reporting of test results. The JTD will execute the JADS JT&E in accordance with the approved test documentation. The JTD will establish a Technical Advisory Group (TAG) to provide independent technical review of the teas documentation. Additionally, the JTD may, as an option, establish a Flag Officer Steering Committee as an advisory body to provide a senior level forum for JCS/Service guidance and coordination of JADS documentation.

JADS is chartered to investigate the utility of Advanced Distributed Simulation (ADS) for both developmental test and evaluation (DT&E) and operational test and evaluation (OT&E). JADS will investigate the present utility of ADS, including Distributed Interactive Simulation (DIS), for T&E; identify the critical constraints, concerns, the methodologies when using ADS for T&E; and finally, identify the requirements that must be introduced into ADS systems if they are to support a more complete T&E capability in the future.

The Air Force, as the lead Service, will provide the necessary military/civilian manpower and funding for their salaries, base administrative support, and facilities (office space and equipment) to ensure that the JT&E is expeditiously and adequately staffed and properly executed in a timely manner. The other participating Services will provide additional military/civilian manpower funding for their salaries as required in accordance with the Feasibility Study. The Services will provide any security clearance/billets as may be required.

JADS will seek to leverage limited resources through augmentation of JCS and Service exercises and planned testing, drawing upon the resources already committed to participate in these events. This will be accomplished using DoD equipment, facilities, and personnel wherever reasonably practical and cost effective. JADS will operate in consonance with the Services and their field agencies through the JTD's Service Deputies.

In order to assure smooth JT&E initiation and successful completion, the lead Service will insure that adequate technical and administrative support to the JTD is provided, including staffing and financial management assistance, communication and computer equipment management, security and environmental consulting, and access to lessons learned from past JT&E.

In accordance with this charter, the JTD will:

a. Establish a headquarters site.

b. Effect coordination with the appropriate Service Agencies to fulfill personnel requirements for the formulation of an effective operational and technical staff .

c. In preparing the PTP, design a JT&E program in coordination with the Joint Staff, the Services, and cognizant Unified and Specified Commands that builds upon the JADS PTD. Provide the PTD to DDT&E (A&SP) for approval within 30 days after charter. Provide the detailed PTP and evaluation plan to DDT&E (A&SP) for review within 180 days after approval of the PTD.

d. Develop an additional PTD that defines the requirements, testing, evaluation, and resources necessary to incorporate electronic warfare (EW) testing into the JT&E. The EW PTD is to be reviewed by the TAB and provided to the DDT&E(A&SP) by April 1995.

e. Determine and provide to DDT&E (A&SP) an estimate of the resources necessary to complete the JT&E. As the detailed JADS test plans are developed, estimates of required resources should be refined and coordinated with the Services, Joint Staff, find other DoD Agencies as appropriate. Test costs should be minimized to the extent feasible while achieving test objectives yet staying within program budget goals. DDT&E(A&SP) will determine the scope of the final resource commitment.

f. Develop a comprehensive OPSEC plan to protect sensitive aspects, as appropriate, of programs addressed in this JT&E.

g. Establish liaison with related Service test programs and incorporate into the PTP and other test plans any pertinent concepts or technology.

h. Develop a transition plan for JADS products that will enable the DoD T&E community to benefit from these products when the JT&E is completed.

i. After final review and approval by DDT&E(A&SP) of the detailed PTP and the resource requirements:

(1) Conduct the joint test program and collect and evaluate the data. Ensure timely availability of test data.

(2) Submit joint test reports to OSD, the CINCs, Services, Joint Staff, and appropriate agencies as directed by DDT&E(A&SP); and

(3) Prepare and report to OSD, the CINCs, Services, Joint Staff, and appropriate agencies a comprehensive final JT&E report, to include recommendations for implementing JADS's findings

j. Submit monthly program progress and financial reports to DDT&£(A&SP),

In order to accomplish his duties, the JTD, as a directed OSD representative, is authorized to:

a. After service coordination, task appropriate Service and DoD Agencies identified by representative Service/Command authorities to support the JT&E and to assist in the evaluation in conformance with the objectives stated in the detailed joint test plans.

b. Manage the funding made available for the conduct of this JT&E. Coordinate transfer of funds to participating agencies as necessary and provide financial status to the DDT&E(A&SP).

c. Establish priorities for resources identified in the individual JADS test plans to accomplish the JT&E.

d. Establish direct liaison with the DoD agencies required to support this JT&E.

e. As a last resort, utilize contractor support in the areas of planning, testing, and data collection when assistance cannot be provided by the lead Service, or other agencies within DoD. This support shall be consistent with the program budget approved by DDT&E (A&SP).

f. Require contractors receiving such funds to furnish to the JTD such status reports as may be deemed necessary to determine timely progress of the JT&E.

g. Obtain coordination of the test plans and resource requirements with DoD, the Joint Staff, Unified and Specified Commands and Service elements as necessary. While retaining the independent status of the joint test results, report the JT&E results to all appropriate DoD agencies.

Reporting channels for the JTD are as follows:

a. Directly to the DDT&E(A&SP) for matters related to DoD funding, test policy (design, plan analysis), and program direction and execution.

b. Through DDT&E (A&SP), the Joint Staff, and the Services for reporting of formalized JT&E results. Direct communication for informational purposes between the JTD and all elements participating in and associated with the JT&E is authorized and encouraged.

John A Burt
Director
Test and Evaluation

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Glossary

A Glossary of Modeling and Simulation Terms for Distributed Simulation

The first two glossaries that follow are taken directly from the DIS Lexicon. The third section contains terms used by JADS that differ from the accepted DIS definitions. These modified or unique terms will be submitted to the Lexicon committee for future inclusion.

A Glossary of Modeling and Simulation Terms for Distributed Interactive Simulation (DIS)

This document was prepared by a Working Group chaired by William Tucker.

This glossary defines terms in the field of Modeling and Simulation. Emphasis is placed on definitions related to Distributed Interactive Simulation (DIS). Other topics covered include general modeling and simulation concepts, types of models and simulations, modeling and simulation variables, game theory, and queueing theory. Part I of this glossary contains terms specific to DIS. Part II contains other terms related to modeling and simulation.

Terms parochial to one group or organization; company proprietary or trademarked; multi-word terms whose meaning could be inferred from the definitions of the component words; terms with commonly accepted definitions contained in a standard dictionary; or terms whose meaning in the computer field could be directly inferred from their standard English meaning were excluded.

Entries in the dictionary are arranged alphabetically. An entry may consist of a single word, such as “model” or a phrase, such as “analytical model.” Phrases are given in their natural order (analytical model) rather than in reversed order (model, analytical).

Blanks precede all other characters in alphabetizing. Hyphens and slashes are treated as blanks. Alternative spellings are shown in parentheses; for example, “human centered (human centred).”

If a term has more than one definition, the definitions are numbered. The order of the definitions does not imply preference or frequency of use. In most cases, noun definitions are given first, followed by verb and adjective definitions as applicable. Examples and notes have been added to clarify selected definitions.

The following cross-references are used to show a term’s relationship to other terms in the dictionary:

(l) **Contrast with** refers to a term with an opposite or substantially different meaning.
(2) **Syn** refers to a synonymous term.
(3) **See also** refers to a related term.
(4) **See** refers to a preferred term or to a term where the desired definition can be found.

Terms Specific to Distributed Interactive Simulation

A

Accreditation. See: distributed simulation accreditation, model/simulation accreditation.
Accuracy. The degree of exactness of a model or simulation, relative to an established standard, high accuracy implying low error. [DIS]
Activity. An event that consumes time and resources and whose performance is necessary for a system to move from one event to the next. [DIS]
Advanced Distributed Simulation (ADS). A set of disparate models or simulations operating in a common synthetic environment. The ADS may be composed of three modes of simulation: live, virtual and constructive which can be seamlessly integrated within a single exercise. **See also:** live simulation; virtual simulation; constructive simulation. [DIS]
Aggregate. An activity that combines individual entities into a singular entity. **Contrast with:** disaggregate. [DIS]
Algorithm Checks. A rigorous verification of the mathematics of an algorithm to ensure freedom from any errors in the expression (e.g., incorrect signs, incorrect variables applied in the equations, derivation errors) and to ensure that the algorithms are consistent with their stated intents. [DIS]
Application Layer. The layer of the ISO reference model (ISO 7498) that provides the means for user application processes to access and use the network's communications resources. **See:** Open Systems Interconnection (OSI), simulation application. [IEEE 1278.1, IEEE 1278.2]
Articulated Part. A visible part of a simulated entity that may not move relative to the entity, but is able to move relative to the entity itself. [IEEE 1278.1]
Attached Part. A visible part of a simulated entity that may not move relative to the entity, but that may or may not be present. For example, a bomb on an aircraft wing station. [IEEE 1278.1]

B

Ballistic Munition. Any munition that follows a ballistic trajectory. [IEEE 1278.1]
Battlefield View. See: entity perspective. [DIS]
Battlespace. The three dimensional battlefield. [DIS]
Benchmark. (v) The activity of comparing the results of a model or simulation with an accepted representation of the process being modeled. (n) The accepted representation of the modeled process. [DIS]
Best Effort Service. A communication service in which transmitted data is not acknowledged. Such data typically arrives in order, complete and without errors. However, if an error occurs, or a packet is not delivered, nothing is done to correct it (e.g., there is no retransmission). [IEEE 1278.1]
Bit. The smallest unit of information in the binary system of notation. [IEEE 1278.1]
Black Box Model. A model whose inputs, outputs, and functional performance are known, but whose internal implementation is unknown or irrelevant; for example, a model of a computerized change-return mechanism in a vending machine, in the form of a table that indicates the amount of change to be returned for each amount deposited. **Syn:** input/output model. **Contrast with:** glass box model. [DIS]
Boundary Condition. The values assumed by the variables in a system, model, or simulation when one or more of them is at a limiting value or a value at the edge of the domain of interest. **Contrast with**: final condition; initial condition. [DIS]
Bounding Volume. The six-sided, rectangular enclosing space whose width, length and height are aligned with those of entity. [IEEE 1278.1]
Broadcast. A transmission mode in which a single message is sent to all network destinations, i.e. one-to-all. Broadcast is a special case of multicast. **Contrast with:** multicast; unicast. [IEEE 1278.2]

Built-In Simulation. A special-purpose simulation provided as a component of a simulation language; for example, a simulation of a bank that can be made specific by stating the number of tellers, number of customers, and other parameters. [DIS]
Built-In Simulator. A simulator that is built-in to the system being modeled; for example, an operator training simulator built into the control panel of a power plant such that the system can operate in simulator mode or in normal operating mode. [DIS]
Bundling. The process of packing separate Protocol Data Units (PDU) into composite or aggregated PDU. **Contrast with:** unbundling. [DIS]

C

Compatible. Two or more simulations are DIS compatible if (1) they are DIS compliant and (2) their models and data that send and interpret PDUs support the realization of a common operational environment among the systems (coherent in time and space). **Contrast with:** compliant, interoperable. [DIS]
Compliant. A simulation is DIS compliant if it can send or receive PDUs in accordance with IEEE Standard 1278 and 1278 (Working Drafts). A specific statement must be made regarding the qualifications of each PDU. **Contrast with:** compatible, interoperable. [DIS]
Computer Generated Force (CGF). Simulation of entities on the virtual battlefield. CGF entities may be fully autonomous (needing no human direction) or semi-autonomous (requiring some direction by a human controller who is not a participant in the virtual events). CGF entities represent friendly, OPFOR, and neutral battlefield participants not portrayed by manned simulators. **See:** manned simulator. [DIS]
Conceptual Model. A description of the content and internal representations which are the user's and developer's combined concept of the exercise. It includes logic and algorithms and explicitly recognizes assumptions and limitations. [DIS]
Concrete Model. A model in which at least one component represented is a tangible object; for example, a physical replica of a building. [DIS]
Condition. The values assumed at a given instant by the variables in a system, model, or simulation. **See also:** boundary condition; final condition; initial condition; state. [DIS]
Conditional Event. A sequentially dependent event that will occur only if some other event has already taken place. See also: time-dependent event. [DIS]
Constructive Simulation. Models and simulations that involve simulated people operating simulated systems. **See Also:** war games; Higher Order Model (HOM). [DIS]
Continuous Model. (l) A mathematical or computational model whose output variables change in a continuous manner; that is, in changing from one value to another, a variable can take on all intermediate values; for example, a model depicting the rate of air flow over an airplane wing. **Syn:** continuous-variable model. (2) A model of a system that behaves in a continuous manner. **Contrast with:** discrete model. [DIS]
Continuous Simulation. A simulation that uses a continuous model. [DIS]
Continuous-Variable Model. See: continuous model. [DIS]
Control Station. (1) Facility which provides the individual responsible for controlling the simulation and which provides the capability to implement simulation control as Protocol Data Units (PDUs) on the Distributed Interactive Simulation (DIS) network. **Syn:** simulation **-** management station. [DIS]

D

Data. Representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation or processing by humans or automatic means. [DIS]
Database. A collection of data, organized according to a schema to serve one or more applications. [DIS]
Data Certification. (1) The determination that data have been verified and validated. (2) Data producer certification is the determination by the data producer that data have been verified and validated against documented standards of criteria. (3) Data user certification is the determination by the application sponsor or designated agent that data have been verified and validated as appropriate for the specific M&S usage. [DIS]

Data Logger. A device that accepts Protocol Data Units (PDUs) from the network and stores them for later replay in the same time sequence as the PDUs were originally received. **See also:** Protocol Data Unit (PDU). [IEEE 1278.3]

Data Validation. The documented assessment of data by subject area experts and its comparison to known or best-estimate values. Data producer validation is that documented assessment within stated criteria and assumptions. Data user validation is that documented assessment of data as appropriate for use in an intended M&S. [DIS]

Data Verification. (1) The use of techniques and procedures to ensure that data meets specified constraints defined by data standards and business rules. (2) Data producer verification is the use of techniques and procedures to ensure that data meets constraints defined by data standards and business rules derived from process and data modeling. (3) Data user verification is the use of techniques and procedures to ensure that data meets user specified constraints defined by data standards and business rules derived from process and data modeling and that data are transformed and formatted properly. [DIS]

Data Verification, Validation, and Certification. The process of verifying the internal consistency and correctness of data, validating that it represents real world entities appropriate for its intended purpose or an expected range of purposes, and certifying it as having a specified level of quality or as being appropriate for a specified use, type of use, or range of uses. The process has two perspectives: producer and user process. **See:** data validation, data verification, and data certification. [DIS]

Dead Reckoning. See: remote entity approximation.

Deaggregate: See: disaggregate. [DIS]

Demonstration. See: exercise.[DIS]

Dependent Variable. A variable whose value is dependent on the values of one or more independent variables. **Contrast with:** independent variable. [DIS]

Descriptive Model. A model used to depict the behavior or properties of an existing system or type of system; for example, a scale model or written specification used to convey to potential buyers the physical and performance characteristics of a computer. **Syn:** representational model. **Contrast with:** prescriptive model. [DIS]

Deterministic. Pertaining to a process, model, or variable whose outcome, result, or value does not depend on chance. **Contrast with:** stochastic. [DIS]

Deterministic Model. A model in which the results are determined through known relationships among the states and events, and in which a given input will always produce the same output; for example, a model depicting a known chemical reaction. **Contrast with:** stochastic model. [DIS]

DIS Control. A mechanism which assists users of Distributed Interactive Simulation (DIS) to direct or dictate aspects of a DIS exercise. **See also:** Distributed Interactive Simulation. [DIS]

DIS Network Manager. A specified agency with the responsibility to manage the physical network used for distributed simulation. Responsibilities include: ensuring security of network; scheduling of utilization; establishing network priorities; monitoring execution of scheduled usage; coordinating functional, technical, and user communities' network requirements. [DIS]

DIS User/Sponsor. Customer requiring Distributed Interactive Simulation (DIS) resources to address training, testing, operational, or analysis objectives. [DIS]

Disaggregate. An activity which decomposes an aggregate entity into multiple entities. **Contrast with:** aggregate. [DIS]

Discrete Change Model. See: discrete model. [DIS]

Discrete Event Model. See: discrete model. [DIS]

Discrete Event Simulation. See: discrete simulation. [DIS]

Discrete Model. (l) A mathematical or computational model whose output variables take on only discrete values; that is, in changing from one value to another, they do not take on the intermediate values; for example, a model that predicts an organization's inventory levels based on varying shipments and receipts. Syn: discrete change model; discrete event model; discrete variable model.(2) A model of a system that behaves in a discrete manner. **Contrast with:** continuous model. **See also:** state machine. [DIS]

Discrete Simulation. A simulation that uses a discrete model. [DIS]

Discrete Variable Model. See: discrete model. [DIS]

Distributed Interactive Simulation (DIS). A time and space coherent synthetic representation of world environments designed for linking the interactive, free play activities of people in operational exercises. The synthetic environment is created through real-time exchange of data units between distributed, computationally

autonomous simulation applications in the form of simulations, simulators, and instrumented equipment interconnected through standard computer communicative services. The computational simulation entities may be present in one location or may be distributed geographically. [IEEE 1278.1, IEEE1278.2]
Distributed Simulation Accreditation. The official certification that a distributed simulation is acceptable for use for a specific purpose. **See also:** model/simulation accreditation. **Contrast with:** distributed simulation validation, distributed simulation verification. [DIS]
Distributed Simulation Validation. The process of determining the degree to which a distributed simulation is an accurate representation of the real world from the perspective of its intended use(s) as defined by the requirements. **See also:** model/simulation validation. **Contract with:** distributed simulation accreditation, distributed simulation verification. [DIS]
Distributed Simulation Verification. The process of determining that an implementation of a distributed simulation accurately represents the developer's conceptual description and specifications. **See also:** model/simulation verification. **Contrast with:** distributed simulation accreditation, distributed simulation validation. [DIS]
Dynamic Model. A model of a system in which there is change, such as the occurrence of events over time or the movement of objects through space; for example, a model of a bridge that is subjected to a moving load to determine characteristics of the bridge under changing stress. **Contrast with:** static model. [DIS]

E

Electronic Battlefield. See: synthetic environment. [DIS]
Empirical. Pertaining to information that is derived from observation, experiment, or experience. [DIS]
Emulate. To represent a system by a model that accepts the same inputs and produces the same outputs as the system represented. For example, to emulate an 8-bit computer with a 32-bit computer. [DIS]
Emulation. (l) A model that accepts the same inputs and produces the same outputs as a given system. (2) The process of developing or using a model as in (1). **See also:** simulation. [DIS]
Emulator. A device, computer program, or system that performs emulation. [DIS]
Entity. Any component in a system that requires explicit representation in a model. Entities possess attributes denoting specific properties. **See:** simulation entity. [DIS]
Entity Coordinate System. Location with respect to a simulation entity is described by an entity coordinate system. [IEEE 1278.1]
Entity Perspective. The perception of the synthetic environment held by a simulation entity based on its knowledge of itself and its interactions with the other simulation entities. This includes not only its own view of the simulated physical environment (terrain, air, and sea), but also its own view of itself, the other entities in the synthetic environment, and of the effects of the other entities on itself and the synthetic environment. **Syn:** world view; battlefield view. [DIS]
Environment. (1) The texture or detail of the domain (such as cities or farmland), sea states, etc.; (2) the external objects, conditions, and processes that influence the behavior of a system (such as terrain relief, weather, day, night, terrain cultural features, etc.) [DIS]
Environmental Entity. A simulation entity which corresponds to dynamic elements of the state of the geographic, atmospheric, and bathyspheric environment, of the synthetic environment, that can be seen or sensed on a real battlefield, for example, craters, smoke, building collapse, weather conditions, and sea state. **See:** simulation entity. [DIS]
Environmental Simulation. (1) A component responsible for maintaining and disseminating the dynamic information on the state of the natural or man-made environment represented in a session, including such things as cratering, smoke, building collapse, weather conditions, and sea state, regardless of their cause. (2) A simulation that depicts all or part of the natural or man-made environment of a system. [DIS]
Environmental Simulator. See: environmental server. [DIS]
Equilibrium. See: steady state. [DIS]
Equilibrium Condition. See: final condition. [DIS]
Error Model. (l) A model used to estimate or predict the extent of deviation of the behavior of an actual system from the desired behavior of the system; for example, a model of a communications channel, used to estimate the

number of transmission errors that can be expected in the channel. (2) In software evaluation, a model used to estimate or predict the number of remaining faults, required test time, and similar characteristics of a system. **Syn:** error prediction model. [DIS]

Error Prediction Model. See: error model. [DIS]

Euler Angles. A set of three angles used to describe the orientation of an entity as a set of three successive rotations about three different orthogonal axes (x, y, and z). The order of rotation is first about z by angle (psi), then about the new y by angle (theta), then about the newest x by angle (phi). Angles psi and phi range between +/- pi, while angle theta ranges only between +/- pi/2 radians. These angles specify the successive rotations needed to transform from the world coordinate system to the entity coordinate system. The positive direction of rotation about an axis is defined by the right-hand rule. [IEEE 1278.1]

Event. (l) An occurrence that causes a change of state in a simulation. **See also:** conditional event; time-dependent event. (2) The instant in time at which a change in some variable occurs. [DIS]

Event-Driven Simulation. See: event-oriented simulation. [DIS]

Event-Oriented Simulation. A simulation in which attention is focused on the occurrence of events and the times at which those events occur; for example, a simulation of a digital circuit that focuses on the time of state transition. **Syn:** event-driven simulation; event-sequenced simulation. [DIS]

Event-Sequenced Simulation. See: event-oriented simulation. [DIS]

Exercise. (1) One or more sessions with a common objective and accreditation. (2) The total process of designing, assembling, testing, conducting, evaluating, and reporting on an activity. **See:** simulation exercise. **Syn:** experiment, demonstration. [DIS, IEEE 1278.3]

Exercise Controller. Individual(s) who assist the Exercise Manager. **See:** exercise manager. [DIS]

Exercise Database. A Distributed Interactive Simulation (DIS) database which includes initialization data, network, simulation entity, environment and control data. [DIS]

Exercise Identifier. Identifying number shared by all simulators participating in a simulation exercise. [DIS]

Exercise Manager. Test director or training officer who manages the setup, control, and feedback of a simulation exercise after the computer network is activated. This individual is part of the user organization. **Syn:** simulation manager. [DIS]

Exercise Segment. A discrete and bounded segment of an exercise. Exercise segments may occur in a series (a linear conduct of an exercise broken into segments by save state records) or parallel (multiple runs starting from the same initial condition). [DIS]

Experiment. See: exercise. [DIS]

F

Face Validation. The process of determining whether a model or simulation based on performance, seems reasonable to people knowledgeable about the system under study. The process does not review software code or logic but rather reviews the inputs and outputs to assure they appear realistic or representative. [DIS]

Fair Fight: Two or more simulations may be considered to be engaged in fair fight when differences in the simulation's performance characteristics have significantly less effect on the outcome of the conflict than actions taken by the simulation participants. **Syn:** level playing field. [DIS]

Fast Time. (l) Simulated time with the property that a given period of actual time represents more than that period of time in the system being modeled; for example, in a simulation of plant growth, running the simulation for one second may result in the model advancing time by one full day; that is, simulated time advances faster than actual time. (2) The duration of activities within a simulation in which simulated time advances faster than actual time. **Contrast with:** real time; slow time. [DIS]

Feature. A static element of the synthetic environment which exists but does not actively participate in synthetic environment interactions. Features are represented in the implementation environment by cartographic databases that are used by simulation assets. Entities can interact with features (building them, destroying them, colliding with them, etc.), but features are passive in that they do not initiate action. When features are dynamic (e.g., dynamic terrain) they are called environment entities. **See:** environmental entity; synthetic environment. [DIS]

Fidelity. (1) The similarity, both physical and functional, between the simulation and that which it simulates. (2) A measure of the realism of a simulation. (3) The degree to which the representation within a simulation is similar to a real world object, feature, or condition in a measurable or perceivable manner. **See also:** model/simulation validation. [DIS, IEEE 1278.1]

Fidelity Domain. Resource that may affect the fidelity of a Distributed Interactive Simulation (DIS) exercise. (Examples are battle space entities, environments, hosts, and sites). [DIS]

Fidelity Management. A process to level the playing field (create a fair fight) by varying fidelity of dissimilar simulators in a controlled fashion. **See:** fair fight. [DIS]

Fidelity Taxonomy. A hierarchy of fidelity definitions. The levels of the taxonomy are resource, domain, capability, implementation, characteristic, and descriptor. [DIS]

Field. (1) A series of contiguous bits treated as an instance of a particular data type that may be part of a higher level data structure. (2) An external operating area for actual vehicles or live entities. **See:** field instrumentation. [DIS, IEEE 1278.1]

Field Instrumentation (FI). An internal or external recording, monitoring, and relaying device employed by live instrumented entities, usually platform, facility, or exercise-unique, and not typically part of the operational system or equipment. These devices provide an independent source of data to assess the performance of operational systems involved in the exercise. **See also:** live entity; live instrumented entity. [DIS]

Filtering. Accepting or rejecting Protocol Data Units (PDUs) received on the network based upon specified criteria, which may be dynamically varied. Examples include geographical filtering and entity type filtering. [DIS]

Final Condition. The values assumed by the variables in a system, model, or simulation at the completion of some specified duration of time. **Syn:** equilibrium condition. **Contrast with:** boundary condition; initial condition. [DIS]

Final State. The values assumed by the state variables of a system, component, or simulation at the completion of some specified duration of time. **Contrast with:** initial state. [DIS]

G

Game. A physical or mental competition in which the participants, called players, seek to achieve some objective within a given set of rules. **See also:** game theory. [DIS]

Game Theory. (l) The study of situations involving competing interests, modeled in terms of the strategies, probabilities, actions, gains, and losses of opposing players in a game. **See also:** management game; war game. (2) The study of games to determine the probability of winning given various strategies. [DIS]

Gaming Simulation. See: simulation game. [DIS]

Glass Box Model. A model whose internal implementation is known and fully visible; for example, a model of a computerized change-return mechanism in a vending machine, in the form of a diagram of the circuits and gears that make the change. **Contrast with:** black box model. **Syn:** white box model. [DIS]

Granularity: See: resolution. [DIS]

Graphical Model. A symbolic model whose properties are expressed in diagrams; for example, a decision tree used to express a complex procedure. **Contrast with:** mathematical model; narrative model; software model; tabular model. [DIS]

Ground Truth. The actual facts of a situation, without errors introduced by sensors or human perception and judgment. [DIS]

Guise. A function that provides the capability for an entity to be viewed with one appearance by one group of participants, and with another appearance by another group. [IEEE 1278.1]

H

Heterogeneous Network. A collection of simulations with partially consistent behaviors and/or partially correlated data bases. Examples include simulators of different fidelity, mixed virtual and live simulations, and mixes of virtual and constructive simulations. [DIS]

Heuristic. Pertaining to experimental, especially trial-and-error, methods of problem-solving. Note: The resulting solution may not be the most desirable solution to the problem. [DIS]

Higher Order Model (HOM). A computer model representing simulation elements, their functions and/or the terrain they operate on in an aggregated manner. A HOM may represent a battalion as a specific entity which is a conglomeration or averaging of the characteristics of its real-world components. “Higher order” generally refers to

echelons battalion and above with coarser than 100m resolution, e.g., 3km, and with faster than real-time performance (e.g., days compressed into minutes, hours into seconds). **See:** model order. **See also:** war game; constructive simulation. [DIS]
Host Computer. A computer that supports one or more simulation applications. All host computers participating in a simulation exercise are connected by network(s) including Wide Area Networks, Local Area Networks, and RF links. [DIS, IEEE 1278.2]
Human-in-the-Loop Model. See: interactive model.
Human-Machine Simulation. A simulation carried out by both human participants and computers, typically with the human participants asked to make decisions and a computer performing processing based on those decisions. [DIS]

I

Iconic Model. A physical model or graphical display that looks like the system being modeled; for example, a non-functional replica of a computer tape drive used for display purposes. **See also:** scale model. [DIS]
Identity Simulation. A simulation in which the roles of the participants are investigated or defined; for example, a simulation that identifies aircraft based on their physical profiles, speed, altitude, and acoustic characteristics. [DIS]
Implementation. The means by which a synthetic environment, or portions of a synthetic environment, is realized. [DIS]
Independent Variable. A variable whose value is not dependent on the values of other variables. **Contrast with:** dependent variable. [DIS]
Independent Verification and Validation (IV&V). The conduct of verification and validation of a model or simulation by individuals or agencies that did not develop the model or simulation. [DIS]
Initial Condition. The values assumed by the variables in a system, model, or simulation at the beginning of some specified duration of time. **Contrast with:** boundary condition; final condition. [DIS]
Initial State. The values assumed by the state variables of a system, component, or simulation at the beginning of some specified duration of time. **Contrast with:** final state. [DIS]
Input/Output Model. See: black box model. [DIS]
Instructional Simulation. A simulation intended to provide real or hypothesized stimuli that could occur in the synthetic environment for the purpose of training. [DIS]
Interactive Model. A model that requires human participation. **Syn:** human-in-the-loop model. [DIS]
Interoperable: Two or more simulations are DIS interoperable for a given exercise if they are DIS compliant, DIS compatible, and their performance characteristics support a fair fight to the fidelity required for the exercise. **Contrast with:** compatible, compliant. [DIS]
Interoperability. (1) The ability of a set of simulation entities to interact with an acceptable degree of fidelity. The acceptability of a model is determined by the user for the specific purpose of the exercise, test, or analysis. (2) The ability of a set of Distributed Interactive Simulation applications to interact through the exchange of Protocol Data Units. [DIS]

L

Lead Variable. (l) In a discrete simulation, a variable that is an output of one period and that predicts what the output of some future period will be. (2) In an analog simulation, a variable that is a function of an output variable and that is used as input to the simulation to provide advanced time response or feedback. [DIS]
Le Systeme International di'Unites (SI). A universal system of metric weights and measures adopted in 1960 by the international authority on the metric system, the Conference Generale des Poids et Measures (CGPM). [DIS]
Level Playing Field. See: fair fight. [DIS]
Live Entity. A perceptible object that can appear in the virtual battlespace but is unaware and non-responsive (either by intent, lack of capability or circumstance) to the actions of virtual entities. **See also:** field instrumentation. **Contrast with:** live instrumented entity. [DIS]

Live Instrumented Entity. A physical entity that is in the real world and can be represented in the Distributed Interactive Simulation (DIS) virtual battlespace which can be manned or unmanned. The live instrumented entity has internal and/or external Field Instrumentation (FI) devices/systems to record and relay the entity's surroundings, behavior, and/or reaction to events. If the FI provides a two-way link, the events that affect the live instrumented entity can be occurring in the virtual battlespace as well as the real world. **See also:** field instrumentation, live entity. [DIS]
Live Simulation. A representation of military operations using operational personnel and equipment in which simulated experiences are achieved in realistic conditions. Typical live simulations are operational testing, field exercises, training exercises and force-on-force exercises. Participants in live simulation perceive the environment via actual sensors or directly with their own eyes. [DIS]
Local Area Network (LAN). A class of data network which provides high data rate interconnection between network nodes in close physical proximity. [IEEE 1278.3]
Long Haul Network (LHN). See: wide area network (WAN). [DIS]

M

Man-Machine Simulation. See: human-machine simulation. [DIS]
Management Game. A simulation game in which participants seek to achieve a specified management objective given pre-established resources and constraints; for example, a simulation in which participants make decisions designed to maximize profit in a given business situation and a computer determines the results of those decisions. **See also:** war game. [DIS]
Manned Platform Entity. Corresponds to current or proposed entities which are driven, guided, flown, or otherwise have a warfighter, staff, or crew in the loop. This includes command posts and other command, control, communication, and intelligence (C3I) nodes and may include role players representing other entities or staff functions. [DIS]
Mathematical Model. A symbolic model whose properties are expressed in mathematical symbols and relationships; for example, a model of a nation's economy expressed as a set of equations. **Contrast with:** graphical model; narrative model; software model; tabular model. [DIS]
Measure of Effectiveness (MOE). Measure of how the system/individual performs its functions in a given environment. Used to evaluate alternative approaches' ability to meet functional objectives and mission needs. Examples of such measures include loss exchange results, force effectiveness contributions, and tons delivered per day. **See also:** Measure of Performance (MOP). [DIS]
Measure of Performance (MOP). Measure of how the system/individual performs its functions in a given environment (e.g., number of targets detected, reaction time, number of targets nominated, susceptibility of deception, task completion time). It is closely related to inherent parameters (physical and structural), but measures attributes of system behavior. **See also:** Measures of Effectiveness (MOE). [IEE 1278.3]
Mock-Up. A full-sized, structural model built accurately to scale, chiefly for study, testing, or display. [DIS]
Model. (l) An approximation, representation, or idealization of selected aspects of the structure, behavior, operation, or other characteristics of a real-world process, concept, or system. Note: Models may have other models as components. (2) To serve as a model as in (1). (3) To develop or use a model as in (1). (4) A mathematical or otherwise logical representation of a system or a system's behavior over time. [DIS]
Model Order. An integer indicating the highest derivative of terms contained in a differential or difference equation for model state. [DIS]
Model/Simulation Accreditation. The official certification that a model or simulation is acceptable for use for a specific purpose. **See also:** distributed simulation accreditation. **Contrast with:** model/simulation validation, model/simulation verification. [DoDD 5000.59]
Model/Simulation Validation. The process of determining the degree to which a model is an accurate representation of the real world from the perspective of the intended use(s) of the model. **See also:** distributed simulation validation, fidelity. **Contrast with:** model simulation accreditation, model simulation verification. [DoDD 5000.59]

Model/Simulation Verification. The process of determining that a model implementation accurately represents the developer's conceptual description and specifications. **See also:** distributed simulation verification. **Contrast with:** model simulation accreditation, model simulation validation. [DoDD 5000.59]
Model/Tool Provider. Organization that develops, stocks, stores and issues simulation assets including simulation models, analysis tools, databases, etc. and maintains historical usage and VV&A records. [DIS]
Monte Carlo Method. In modeling and simulation, any method that employs random statistical techniques simulation to determine estimates for unknown values in a deterministic problem. **See:** stochastic model. [DIS]
Monte Carlo Simulation. A simulation in which random statistical sampling techniques are employed such that the result determines estimates for unknown values. [DIS]
Multicast. A transmission mode in which a single message is sent to selected multiple (but not necessarily all) network destinations, i.e., one-to-many. **Contrast with:** broadcast, unicast. [IEEE 1278.1, IEEE 1278.2]

N

Narrative Model. A symbolic model the properties of which are expressed in words; for example, a written specification for a computer system. **Syn:** verbal-descriptive model. **Contrast with:** graphical model; mathematical model; software model; tabular model. [DIS]
Natural Model. A model that represents a system by another system that already exists in the real world; for example, a model that uses one body of water to represent another. [DIS]
Network Filter. A system to selectively accept or reject data received from the network. [DIS]
Network Management. The collection of administrative structures, policies, and procedures that collectively provide for the management of the organization and operation of the distributed simulation communication network as a whole. **See:** network manager. [IEEE 1278.1]
Network Manager. The person or organization responsible for maintaining, monitoring, and scheduling the operation of the portion of a network used for a distributed simulation and whose responsibilities for the network terminates at the gateways and who is not responsible for the simulation hosts or a local area network. Normally, also in charge of the gateway and not part of the user organization. **See:** network management. [DIS]
Network Node: A specific network address. **See:** node. **Contract with:** processing node. [DIS]
Nodalization. (l) The set of nodes within a system being modeled. (2) The process of developing the nodes as in (l). [DIS]
Node. A general term denoting either a switching element in a network or a host computer attached to a network. **See:** processing node; network node. [IEEE 1278.1, IEEE 1278.2]
Normative Model. A model that makes use of a familiar situation to represent a less familiar one; for example, a model that depicts the human cardiovascular system by using a mechanical pump, rubber hoses, and water. [DIS]
Numerical Model. (l) A mathematical model in which a set of mathematical operations are reduced to a form suitable for solution by a simpler methods such as numerical analysis or automation; for example, a model in which a single equation representing a nation's economy is replaced by a large set of simple averages based on empirical observations of inflation rate, unemployment rate, gross national product, and other indicators. (2) A model whose properties are expressed by numbers. [DIS]

O

Object Based. A software design methodology adhering to the concepts and goals of object orientation without necessarily utilizing the all language specific mechanisms of encapsulation, inheritance, message passing, and dynamic binding. For example, A-83 does not have inheritance as a language mechanism, but other mechanisms achieve a similar effect. In this case, generic units and abstract data types carry the intent of inheritance. The concepts and goals of object orientation include a consistent map between the problem space and the solution space (each module in the system denotes an object or class of objects from the problem space), abstraction, information-hiding. **See:** object-oriented. [DIS]
Object Oriented. (1) A software design methodology that (when applied to Distributed Interactive Simulation) results in the battlefield being represented by objects which encapsulate associated methods or procedures and where objects communicate by message passing. Examples of battlefield objects are platoons (unit level), tanks,

(platform level), main guns (component or module level), and gun barrels (part level). Object oriented designs have inherent modularity; e.g., to change a tank model only the tank object must be changed. **See also:** object based. (2) An approach to software design and implementation in which the decomposition of a system is based upon the concept of an object. An object is an entity whose behavior is characterized by the operations that it suffers and that is required of other objects. By suffers an operation, we mean that the given operation can legally be performed upon the object. Object Oriented Design (OOD) attempts to manage the complexity inherent in real-world problems by abstracting out knowledge, and encapsulating it within objects. Object oriented methods exist for every phase of the software development lifecycle, hence the interrelated terms of Object Oriented Analysis (OOA), Object Oriented Design, and Object Oriented Programming (OOP). OOD is often used to mean the entire scope of object oriented methods. Object orientation is achieved through the application of certain techniques and concepts. It is not the use of particular languages or tools. [DIS]

Octet. A sequence of eight bits, usually operated upon as a unit. [IEEE 1278.1]

Open Systems Environment. A Distributed Interactive Simulation (DIS) environment having attributes of interoperability and portability which promotes competition by allowing systems developed by multiple vendors and nations to interoperate through a common set of computer and communications protocols. **Syn:** Open Systems Interconnection (OSI). [DIS]

Operational Environment. A composite of the conditions, circumstances, and influences which affect the employment of military (or other) forces and the decisions of the unit commander or person in charge. [DIS]

Open Systems Interconnection (OSI). Syn: open systems environment. [DIS]

Outcome-Oriented Simulation. A simulation in which the end result is considered more important than the process by which it is obtained; for example, a simulation of a radar system that uses methods far different from those used by the actual radar, but whose output is the same. **Contrast with:** process-oriented simulation. [DIS]

P

Period. The time interval between successive events in a discrete simulation. [DIS]

Physical Model. A model whose physical characteristics resemble those of the system being modeled; for example, a plastic or wooden replica of an airplane. A mock-up. **Contrast with:** symbolic model. **See also:** iconic model; scale model. [DIS]

Plan View Display. A two-dimensional representation in which the observer's eyepoint is above the exercise. [DIS]

Platform. A generic term used to describe a level of representation equating to vehicles, aircraft, missiles, ships, fixed sites, etc. in the hierarchy of representation possibilities. Other representation levels include units (made up of platforms) and components or modules (which make up platforms.) [DIS]

Point to Point Transmission. See: unicast. [DIS]

Predictive Model. A model in which the values of future states can be predicted or are hypothesized; for example, a model that predicts weather patterns based on the current value of temperature, humidity, wind speed, and so on at various locations. [DIS]

Prescriptive Model. A model used to convey the required behavior or properties of a proposed system; for example, a scale model or written specification used to convey to a computer supplier the physical and performance characteristics of a required computer. **Contrast with:** descriptive model. [DIS]

Probabilistic Model. See: stochastic model. [DIS]

Process Model. A model of the processes performed by a system; for example, a model that represents the software development process as a sequence of phases. **Contrast with:** structural model. [DIS]

Process-Oriented Simulation. A simulation in which the process is considered more important than the outcome; for example, a model of a radar system in which the objective is to replicate exactly the radar's operation, and duplication of its results is a lesser concern. **Contrast with:** outcome-oriented simulation. [DIS]

Processing Node. The hardware and software processing resources devoted to one or more simulation entities. **See:** node. **Contract with:** network node. [DIS]

Protocol. A set of rules and formats (semantic and syntactic) that define the communication behavior of simulation applications. [IEEE 1278.1]

Protocol Data Unit. (PDU) A DIS data message that is passed on a network between simulation applications according to a defined protocol. [IEEE 1278.1]

R

Real Battlefield. **See:** real world. [DIS]
Real Time. In modeling and simulation, simulated time advances at the same rate as actual time; for example, running the simulation for one second results in the model advancing time by one second. **Contrast with:** fast time, slow time. [DIS]
Real World. The set of real or hypothetical causes and effects that simulation technology attempts to replicate. When used in a military context, the term is synonymous with real battlefield to include air, land, and sea combat. **Syn:** real battlefield. [DIS]
Real World Time. The actual time in the real world. **Syn:** sidereal time. [IEEE 1278.1]
Reference Version. The most recent version of a model or simulation which has been released by, and under configuration management of an approving authority. [DIS]
Reliability Model. A model used to estimate, measure, or predict the reliability of a system; for example, a model of a computer system, used to estimate the total down time that will be experienced. [DIS]
Reliable Service. A communication service in which the received data is guaranteed to be exactly as transmitted. [IEEE 1278.1, IEEE 1278.2]
Remote Entity Approximation (REA). The process of extrapolating and interpolating any state of an entity based on its last known state. This includes dead reckoning and smoothing. **Syn:** dead reckoning. [DIS]
Representational Model. **See:** descriptive model. [DIS]
Resolution. (1) The degree to which near equal results values can be discriminated. (2) The measure of the ability to delineate picture detail. [DIS]
Right-Hand Rule. Positive rotation is clockwise when viewed toward the positive direction along the axis of rotation. [IEEE 1278.1]

S

Scale Model. A physical model that resembles a given system, with only a change in scale; for example, a replica of an airplane one tenth the size of the actual airplane. [DIS]
Scenario. (1) Description of an exercise (initial conditions). It is part of the session database which configures the units and platforms and places them in specific locations with specific missions. (2) An initial set of conditions and time line of significant events imposed on trainees or systems to achieve exercise objectives. **See:** field exercise. [DIS, IEEE 1278.3]
Segment. A portion of a session that is contiguous in simulation time and in wall-clock time (sidereal time). [IEEE 1278.3]
Semi-Automated Forces (SAFOR). See: Computer Generated Forces (CGF). [DIS]
Session. A portion of an exercise that is contiguous in wall-clock (sidereal) time and that is initialized per an exercise database. [IEEE 1278.3]
Session Manager. See: exercise manager. [DIS]
Sidereal Time: Time measured with respect to the stars. Time that is independent of simulation clocks, time zones, or measurement errors. The “Ground Truth” of time measurement. [DIS]
SIMNET. (Simulator Networking) The prototype distributed simulation upon which DIS was based. [DIS]
Simuland. The system being represented by a simulation. [DIS]
Simulate. To represent a system by a model that behaves or operates like the system. **See also:** emulate. [DIS]
Simulated Time. Time as represented within a simulation. **Syn:** virtual time. **See also:** fast time; real time; slow time. [DIS]
Simulation. (l) A model that behaves or operates like a given system when provided a set of controlled inputs. A model that represents some aspect of the simuland’s behavior. **Syn:** simulation model. **See also:** emulation. (2) The process of developing or using a model as in (1). (3) An implementation of a special kind of model that represents at least some key internal elements of a system and describes how those elements interact over time. [DIS]

Simulation Application. (1) The executing software on a host computer that models all or part of the representation of one or more simulation entities. The simulation application represents or "simulates" real-world phenomena for the purpose of training or experimentation. Examples include manned vehicle (virtual) simulators, computer generated forces (constructive), environment simulators, and computer interfaces between a Distributed Interactive Simulation (DIS) network and real (live) equipment. The simulation application receives and processes information concerning entities created by peer simulation applications through the exchange of DIS PDUs. More than one simulation application may simultaneously execute on a host computer. (2) The application layer protocol entity that implements standard DIS protocol. **Syn:** simulation. [DIS, IEEE 1278.1]

Simulation Entity. An element of the synthetic environment that is created and controlled by a simulation application and affected by the exchange of DIS PDUs. Examples of types of simulated entities are: tank, submarine, carrier, fighter aircraft, missiles, bridges, or other elements of the synthetic environment. It is possible that a simulation application may be controlling more than one simulation entity. **See:** entity. [IEEE 1278.1]

Simulation Environment. (1) Consists of the natural physical environment surrounding the simulation entities including land, oceans, atmosphere, near-space, and cultural information. (2) All the conditions, circumstances, and influences surrounding and affecting simulation entities including those stated in (1). [DIS]

Simulation Exercise. An exercise that consists of one or more interacting simulation applications. Simulations participating in the same simulation exercise share a common identifying number called the Exercise Identifier. These simulations also utilize correlated representations of the synthetic environment in which they operate. **See:** live simulation. [IEEE 1278.1, IEEE 1278.2]

Simulation Fidelity. Refers to the degree of similarity between the simulated situation and the operational situation. [IEEE 1278.3]

Simulation Game. A simulation in which the participants seek to achieve some agreed-upon objective within an established set of rules. For example, a management game, a war game. Note: The objective may not be to compete, but to evaluate the participants, increase their knowledge concerning the simulated scenario, or achieve other goals. **Syn:** gaming simulation. [DIS]

Simulation Language. A programming language used to implement simulations. [DIS]

Simulation Management. A mechanism that provides control of the simulation exercise. Functions of simulation management include: start, restart, maintenance, shutdown of the exercise, and collection and distribution of certain types of data. **See:** exercise manager. [IEEE 1278.1]

Simulation Manager. **See:** exercise manager. [DIS]

Simulation Model. See: simulation. [DIS]

Simulation Process. The imitative representation of the actions of platform(s), munition(s), and life form(s) by computer program(s) in accordance with a mathematical model and the generation of associated battlefield entities. May be fully automated or partially automated. In the latter case, the human-in-the-loop injects command-level decisions into the process and is not intended to be a "trainee." [DIS]

Simulation Support Entity. Processing modules used to support, control, or monitor the simulation environment, but which do not actually exist on the battlefield. This includes battlefield viewing devices for controllers or exercise observers such as the stealth vehicle, the plan view display, after action review systems, and simulation control systems. [DIS]

Simulation Time. (1) A simulation's internal representation of time. Simulation time may accumulate faster, slower, or at the same pace as sidereal time. (2) The reference time (e.g., Universal Coordinated Time) within a simulation exercise. This time is established ahead of time by the simulation management function and is common to all participants in a particular exercise. [DIS, IEEE 1278.1]

Simulator. (1) A device, computer program, or system that performs simulation. (2) For training, a device which duplicates the essential features of a task situation and provides for direct practice. (3) For Distributed Interactive Simulation (DIS), a physical model or simulation of a weapons system, set of weapon systems, or piece of equipment which represents some major aspects of the equipment's operation. [DIS]

Site. (1) An actual physical location at a specific geographic area, e.g., the Fort Knox Close Combat Test Bed (CCTB). (2) A node on the network used for distributed simulation such as the Defense Simulation Internet (DSI) long haul network. (3) A level of configuration authority within a DIS exercise. [DIS]

Site Manager. The individual responsible for the maintenance and operation of the simulators and local area network operations to support the requirement of the users. Additional responsibilities include: providing appropriate terrain; safety and data collection. **See also:** site. [DIS]

Slow Time. The duration of activities within a simulation in which simulated time advances slower than sidereal time. **Contrast with:** fast time; real time. [DIS]
Smoothing. Interpolation of the previous state of an entity (location, velocity, etc.) to the current state, creating a smoothed transition between two successive entity state updates. [DIS]
Software Model. A symbolic model whose properties are expressed in software; for example, a computer program that models the effects of climate on the world economy. **Contrast with:** graphical model; mathematical model; narrative model; tabular model.[DIS]
Sponsor. The sponsor or user is the person or agency who determines the need for a DIS exercise and establishes the funding for the exercise. The sponsor/user also provides exercise objectives, requirements, and specifications. The specific individual within that agency with executive oversight of the DIS exercise is the sponsor/user's agent. This agent in turn appoints the Simulation Manager. [DIS]
Stabilized-Variable Model. A model in which some of the variables are held constant and the others are allowed to vary; for example, a model of a controlled climate in which humidity is held constant and temperature is allowed to vary. [DIS]
State. (1) The internal status of a simulation entity, e.g. fuel level, number of rounds remaining, location of craters, etc. State messages are used to start and restart entities or to update entities concerning the dynamic changes in the environment in their area of interest. **See also:** simulation entity. (2) A condition or mode of existence that a system, component, or simulation may be in; for example, the preflight state of an aircraft navigation program or the input state of given channel. (3) The values assumed at a given instant by the variables that define the characteristics of a system, component, or simulation. **Syn:** system state. **See also:** final state; initial state; steady state. [DIS]
State Machine. A model of a system in which all values are discrete, as in a digital computer. [DIS]
State Transition. A change from one state to another in a system, component, or simulation. [DIS]
State Variable. A variable that defines one of the characteristics of a system, component, or simulation. The values of all such variables define the state of the system, component, or simulation. [DIS]
Static Model. A model of a system in which there is no change; for example, a scale model of a bridge, studied for its appearance rather than for its performance under varying loads. **Contrast with:** dynamic model. [DIS]
Steady State. A situation in which a model, process, or device exhibits stable behavior independent of time. **Syn:** equilibrium. [DIS]
Stealth Viewer. A component that provides the capabilities for visually observing a Distributed Interactive Simulation (DIS) exercise without participating in the DIS exercise interaction. [DIS]
Stimulate. To provide input to a system in order to observe or evaluate the system's response. [DIS]
Stimulator. (1) A hardware device that injects or radiates signals into the sensor system(s) of operational equipment to imitate the effects of platforms, munitions, and environment that are not physically present. (2) A battlefield entity consisting of hardware and/or software modules which injects signals directly into the sensor systems of an actual battlefield entity to simulate other battlefield entities in the virtual battlefield. [DSI]
Stochastic. Pertaining to a process, model, or variable whose outcome, result, or value depends on chance. **Contrast with:** deterministic. [DIS]
Stochastic Model. A model in which the results are determined by using one or more random variables to represent uncertainty about a process or in which a given input will produce an output according to some statistical distribution; for example, a model that estimates the total dollars spent at each of the checkout stations in a supermarket, based on probable number of customers and probable purchase amount of each customer. **Syn:** probabilistic model. **See also:** Markov-chain model. **Contrast with:** deterministic model. [DIS]
Structural Model. A representation of the physical or logical structure of a system; for example, a representation of a computer network as a set of boxes connected by communication lines. **Contrast with:** process model. [DIS]
Symbolic Model. A model whose properties are expressed in symbols. Examples include graphical models, mathematical models, narrative models, software models, and tabular models. **Contrast with:** physical model. [DIS]
Synthetic Environment. The representation of the real world through simulation (the implementation environment); composed of simulation entities, the simulation environment and their interactions. **Syn:** electronic battlefield; virtual world. [DIS]
System State. See: state. [DIS]

T

Time Variable. A variable whose value represents simulated time or the state of the simulation clock. [DIS]
Time-Dependent Event. An event that occurs at a predetermined point in time or after a predetermined period of time has elapsed. **See also:** conditional event.
Tracked Munition. A munition for which tracking data is required. By necessity, a tracked munition becomes a simulation entity during its flight; its flight path is represented, therefore, by Entity State PDUs. [IEEE 1278.1]
Transmit Management. The control of the transmission rate to match the transmission media. The transmission rate is selected to reduce total network traffic. [DIS]
Tutorial Simulation. **See:** instructional simulation. [DIS]

U

Unbundling. The process of unpacking a bundled Protocol Data Unit (PDUs) into multiple separate PDUs. **Contrast with:** bundling. [DIS]
Unicast. A transmission mode in which a single message is sent to a single network destination, i.e., one-to-one. **Contrast with:** broadcast, multicast. [IEEE 1278.1, IEEE 1278.2]
Unit. 1) An aggregation of entities. 2) A basis of measurement. [DIS, IEEE 1278.3]
Unit Conversion. A system of converting measurement from one basis to another; for example, English/metric, knots/feet per second, IEEE floating point, byte swapping, etc. [DIS]
User. Military, industrial, or academic organizations requiring access to the network used for distributed simulation. Prior to use, they will appoint one point of responsibility for their use of the network. This person is the Exercise Manager. **See also:** simulation manager. [DIS]

V

Validation. **See:** data validation, distributed simulation validation, face validation, model/simulation validation. [DIS]
Variable. A quantity or data item whose value can change. **Contrast with:** constant. **See also:** dependent variable; independent variable; state variable. [DIS]
Verbal-Descriptive Model. **See:** narrative model. [DIS]
Verification. **See:** data verification, distributed simulation verification, model/simulation verification
Verification and Validation (V&V) Proponent. The agency responsible for ensuring V&V is performed on a specific model or simulation. [DIS]
Vignette. A self contained portion of a scenario. [DIS]
Virtual Battlespace. The illusion resulting from simulating the actual battlespace. [DIS]
Virtual Network. The interconnection of Distributed Interactive Simulation (DIS) cells by any communications means which provides the necessary network services to conduct an exercise. [DIS]
Virtual Simulation. Form of simulation in which entities exist in effect or in essence, although not in actual form, so that sensing of or by other entities must be via the DIS protocol data unit stream. When participation in a DIS exercise requires significant compromise of vehicle dynamics, the vehicle is then operating in the virtual mode. [DIS]
Virtual Time. **See:** simulated time. [DIS]
Virtual World. **See:** synthetic environment. [DIS]

W

War Game. A simulation game in which participants seek to achieve a specified military objective given pre-established resources and constraints; for example, a simulation in which participants make battlefield decisions and a computer determines the results of those decisions. **See also:** management game. **Syn:** constructive simulation; higher order model (HOM). [DIS]

Warfare Simulation. A model of warfare or any part of warfare for any purpose (such as analysis or training). [DIS]

White Box Model. See: glass box model. [DIS]

Wide Area Network (WAN). A communications network of devices which are separated by substantial geographical distance. **Syn:** long haul network. [IEEE 1278.3]

World Coordinate System. The right-handed geocentric Cartesian system. The shape of the world is described by the WGS 84 standard. The origin of the world coordinate system is the centroid of the earth. The axes of this system are labeled X, Y, and Z, with the positive X-axis passing through the Prime Meridian at the Equator, with the positive Y-axis passing through 90 degrees East longitude at the Equator and the positive Z-axis passing through the North Pole. **See also:** WGS 84. [IEEE 1278.1]

World Geodetic System 1984 (WGS 84). 1984 version of World Geophysical Society Standard earth, mass, and surface distribution model. [DIS]

World View. The view each simulation entity maintains of the simulated world from its own vantage point, based on the results of its own simulation and its processing of event messages received from all external entities. For Computer Generated Forces, the world view is part of the state of the entity. For manned simulators of real vehicles, the world view is the perceptions of the participating humans. [DIS]

General Simulation and Modeling Terms

Absorbing Markov Chain Model. A Markov chain model that has at least one absorbing state and in which from every state it is possible to get to at least one absorbing state. **See also:** absorbing state.
Absorbing State. In a Markov chain model, a state that cannot be left once it is entered. **Contrast with:** nonabsorbing state.
Activity. In discrete event modeling and simulation, a task that consumes time and resources and whose performance is necessary for a system to move from one event to the next.
Activity-Based Simulation. A discrete simulation that represents the components of a system as they proceed from activity to activity; for example, a simulation in which a manufactured product moves from station to station in an assembly line.
Analog Simulation. (l) A simulation that is designed to be executed on an analog system. (2) A simulation that is designed to be executed on a digital system but that represents an analog system. (3) A simulation of an analog circuit. **Contrast with:** digital simulation. **See also:** hybrid simulation.
Analytical Model. A model consisting of a set of solvable equations; for example, a system of solvable equations that represents the laws of supply and demand in the world market.
Critical Event Simulation. A simulation that is terminated by the occurrence of a certain event; for example, a model depicting the year- by-year forces leading up to a volcanic eruption, that is terminated when the volcano in the model erupts. **See also:** time-slice simulation.
Digital Simulation. (l) A simulation that is designed to be executed on a digital system. (2) A simulation that is designed to be executed on an analog system but that represents a digital system. (3) A simulation of a digital circuit. **Contrast with:** analog simulation. **See also:** hybrid simulation.
Endogenous Variable. A variable whose value is determined by conditions and events within a given model. **Syn:** internal variable. **Contrast with**: exogenous variable.
Exogenous Variable. A variable whose value is determined by conditions and events external to a given model. Syn: external variable. **Contrast with:** endogenous variable.
External Variable. See: exogenous variable.
Hybrid Simulation. A simulation, portions of which are designed to be executed on an analog system and portions on a digital system. Interaction between the two portions may take place during execution. **See also:** analog simulation; digital simulation.
In-Basket Simulation. A simulation in which a set of issues is presented to a participant in the form of documents on which action must be taken; for example, a simulation of an unfolding international crisis as a sequence of memos describing relevant events and outcomes of the participant's actions on previous memos.
Internal Variable. See: endogenous variable.
Laboratory Simulation. A simulation developed and used under highly controlled conditions; for example, a simulation of a medical technique implemented in the controlled environment of a laboratory.
Lag Variable. (1) In a discrete simulation, a variable that is an output of one period and an input for some future period. (2) In an analog simulation, a variable that is a function of an output variable and that is used as input to the simulation to provide a time delay response or feedback. **Syn:** lagged variable; serially-correlated variable.
Lagged Variable. See: lag variable.
Machine Simulation. A simulation that is executed on a machine. **See also:** computer simulation.
Markov Chain Model. A discrete, stochastic model in which the probability that the model is in a given state at a certain time depends only on the value of the immediately preceding state. **Syn:** Markov model. **See also:** semi-Markov model.
Markov Model. See: Markov chain model.
Markov Process. A stochastic process which assumes that in a series of random events, the probability for occurrence of each event depends only on the immediately preceding outcome. **See also:** semi-Markov process.
Network Theory. The study of networks used to model processes such as communications, computer performance, routing problems, and project management.
Nonabsorbing State. In a Markov chain model, a state that can be left once it is entered. **Contrast with:** absorbing state.

Petri Net. An abstract, formal model of information flow, showing static and dynamic properties of a system, i.e., the Petri net is defined by its places, transitions, input function, and output function.
Prototype. A preliminary type, form, or instance of a system that serves as a model for later stages or for the final, complete version of the system.
Queue. In queueing theory, a set of zero or more entities waiting to be serviced by a service facility.
Queueing Model. A model consisting of service facilities and entities waiting in queues to be served; for example, a model depicting teller windows and customers at a bank.
Queueing Network Model. A model in which a process is described as a network in which each node represents a service facility rendering a given type of service and a queue for holding entities waiting to be served; for example, a model depicting a network of shipping routes and docking facilities at which ships must form queues in order to unload their cargo.
Queueing Theory. The study of queues and the performance of systems that service entities that are organized into queues. **See also:** queueing model; queueing network model.
Semi-Markov Model. A Markov chain model in which the length of time spent in each state is randomly distributed.
Semi-Markov Process. A Markov process in which the duration of each event is randomly distributed.
Serially-Correlated Variable. See: lag variable.
Simulation Clock. A counter used to accumulate simulated time.
Tabular Model. A model whose properties are expressed in tabular form; for example, a truth table that represents a Boolean logic "OR" function. **Contrast with:** graphical model; mathematical model; narrative model; software model.
Time-Interval Simulation. See: time-slice simulation.
Time-Slice Simulation. (l) A discrete simulation that is terminated after a specific amount of time has elapsed; for example, a model depicting the year-by-year forces affecting a volcanic eruption over a period of 100,000 years. **Syn:** time-interval simulation. **See also**: critical event simulation. (2) A discrete simulation of continuous events in which time advances by intervals chosen independent of the simulated events; for example, a model of a time multiplexed communication system with multiple channels transmitting signals over a single transmission line in very rapid succession.
Yoked Variable. One of two or more variables that are dependent on each other in such a manner that a change in one automatically causes a change in the others.

Terms Specific to Joint Advanced Distributed Simulation (JADS)

This glossary section contains terms that differ or are unique to JADS and not included in the generally accepted morphemics taxonomies.
Player. See: entity (DIS term).

List of Acronyms

Acronym	Definition
AASI	Advanced Aircraft Simulation Interface
ACE	AMRAAM Captive Equipment
ADCU	Adaptive Data Collection Unit
ADS	advanced distributed simulation
AFATADS	Advanced Field Artillery Tactical Data Systems
AFDTC	Air Force Development Test Center
AFOTEC	Air Force Operational Test and Evaluation Center
AMRAAM	Advanced Medium Range Air-to-Air Missile
ARPA	Advanced Research Project Agency
ASAS	All-Source Analysis System

Acronym	Definition
ATACMS	Advanced Tactical Missile System
ATWS	Advanced Technology Work Station
BMIC	Battle Management Interoperability Center
C^2	command and control
C^4I	command, control, communications, computer, and intelligence
CBT	computer based training
CCB	Configuration Control Board
CCF	Central Control Facility
COI	Critical Operational Issue
CONOPS	concept of operations
DARPA	Defense Advanced Research Projects Agency
DDTSE&E	Deputy Director for Testing, Systems Engineering and Evaluation
DEC	Digital Equipment Corporation
DESA	Defense Evaluation Support Activity
DIS	Distributed Interactive Simulation
DLS	Data Link System
DMAP	Data Management Analysis Plan
DMSO	Defense Modeling and Simulation Office
DoD	Department of Defense
DSI	Defense Security Intelligence
DT	developmental testing
DT&E	developmental test and evaluation
DTD	Deputy Test Director
E-NET	Ethernet
EATS	Extended Area Tracking System
ECM	electronic countermeasures
EDS	Engagement Dynamics System
EMI	electro magnetic interference
ESSM	Evolved Sea Sparrow Missile
ETE	End-To-End Test
EW	electronic warfare
FAD	force activity designator
FCE	fire control element
FDC	Fire Direction Center
FDDI	fiber distributed data interface
FOSC	flag office steering committee
GPS	Global Positioning System
GSH	Government Simulation Hardware
GSM	Ground Station Module
GSMR	Ground Station Module Replicator
GWEF	Guided Weapons Evaluation Facility
HOJ	home-on-jam
HWIL	hardware-in-the-loop
IDRL	Integrated Data Requirements List
IEEE	Institute of Electrical and Electronics Engineers
INS	inertial navigation system
IRIS	Internetted Range Interactive Simulations

Acronym	**Definition**
ISSA	Interservice Support Agreement
IST	Information Systems Technology
ITV	Integrated Test Vehicle
JADS	Joint Advanced Distributed Simulation
JCCD	Joint Camouflage, Concealment, and Deception
JDAM	Joint Direct Attack Munition
JFS	Joint Feasibility Study
JSPO	Joint System Program Office
JSTARS	Joint Surveillance Target Attack Radar System
JT&E	Joint Test & Evaluation
JTD	Joint Test Director
JTF	joint test force
JTIDS	Joint Tactical Information Distribution System
LAN	local area network
LEB	Live Entity Broker
LEVR	Live Entity VisualizeR
MISILAB	Missile Lab
MNS	mission needs statements
MOA	Memorandum of Agreement
MOE	measure of effectiveness
MOP	measure of performance
MOT&E	Multiservice Operational Test & Evaluation
MOU	Memorandum of Understanding
MTACS	Multi-object Tracking and Control System
MTI	moving target indication
NAWCWPNS	Naval Air Warfare Center Weapons Division
NRT	near real-time
OPSEC	Operation Security
ORD	operational requirements document
OSD	Office of the Secretary of Defense
OT	Operational Testing
OT&E	operational test and evaluation
OTM	objective tracing matrix
PDU	protocol data unit
Pk	Probability of Kill
PRIMES	Preflight Integration of Munitions and Electronics Systems
PTD	Program Test Design
PTP	Program Test Plan
RAJPO	Range Applications Joint Program Office
RCC	Range Commanders Council
RCC	Range Control Center
RDS	Real-time Data System
RF	radio frequency
RFCS	Radio Frequency Control System
RFTS	Radio Frequency Target Simulator
ROC	required operational capability
RPS	radar processor simulation

Acronym	Definition
RTMM	Removable Transportable Memory Module
SAR	synthetic aperture radar
SCDL	Surveillance Control Data Link
SEDS	Simulation Engagement Display System
SIMNET	Simulation Network
SIT	System Integration Test
SME	subject matter expert
SOJ	stand-off jammer
SSJ	self-screening jammer
STRICOM	US Army Simulation, Training, and Instrumentation Command
SUT	system under test
T&E	test and evaluation
TACFIRE	Tactical Fire
TADIL	Tactical Digital Information Link
TAG	Technical Advisory Group
TAP	test activity plan
TBS	tactical battlefield surveillance
TCAC	Test Control and Analysis Center
TDP	TSPI data processor
TM	telemetry
TSPI	time-space-position information
UAV	unmanned aerial vehicle
VV&A	verification, validation, and accreditation
WAN	wide area network
WBS	work breakdown structure
WSMR	White Sands Missile Range
WSSF	Weapon System Support Facility